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Some of the Physical Characteristics of Ferric Oxide.

[Prepared for Eighth Meeting, American Gas Institute, by MESSRS. W. H. FULWEILER and A. F. KUNBERGER.]

The authors say that the use of ferric oxide in the purification of commercial gases has been the subject of many papers; the chemical theory, the economical rate of flow, the use of air for revivification, reverse flow and deep *versus* shallow boxes, have all been exhaustively treated, but very little attention seems to have been given to the efficiency of the oxide for the decomposition and removal of hydrogen sulphide. It is the purpose of this paper to point out the advantages of using efficient oxide, and some of the physical characteristics and tests by which it may be recognized.

Where the purifying capacity is greatly in excess of the output, the subject of purification is not as important, as in the majority of plants, where, with the yearly increase in sendout, it becomes more and more difficult to secure proper and efficient purification. Under these conditions the boxes must be watched with the greatest care, and the changes, made at a high cost per change, due to the necessity of making them as rapidly as possible. In such conditions, by a more efficient oxide, greatly increased capacity may be had from the existing purification apparatus, saving the additional capital required for extensions, decreasing the capital charge, and greatly reducing the labor cost of changing the oxide and revivifying.

In the Philadelphia Gas Works there has been an insistent demand for greater purifying capacity from the existing equipment, and Mr. C. J. Ramsburg, Assistant Engineer of Works, made a careful study of the question. This work finally centered on the search for an oxide that would allow a very rapid rate of flow, and capable of removing every trace of hydrogen sulphide.

Many samples of oxide, natural and artificial, from this country and abroad, were carefully studied, both practically and in the laboratory, and it was found that certain forms of oxide were very efficient. A reason was sought for this efficiency, and much research work was done in the investigation.

The routine examination of new types of oxide demands a simple method that would yield results sufficiently accurate for the work in hand, in minimum time. Such a method was devised by Mr. A. F. Kunberger, and described in the August 25th issue of the JOURNAL, page 125.

Briefly it consisted in treating a small sample in a tube connected with a second tube containing $CaCl_2$, with previously dried H_2S, the tubes small enough to be accurately made in a chemical balance.

The reaction between H_2S and ferric oxide involves the liberation of water, and as the oxide tested always contains moisture, it is essential that moisture originally in the oxide should not be lost, so by weighing it, together with that evolved in the decomposition, the increase of weight of the tubes gives directly the H_2S decomposed.

The 5-gram samples used are fouled in about an hour, so an oxide may be fouled from 3 to 5 times in a working day. Other tests determined the total oxidized iron, moisture, combined water, and if any adventitious substances were present which might affect the action of the oxide.

An examination of Table 1 shows a considerable variation in efficiency of different oxides, for the decomposition of hydrogen sulphide. It has been well known that different "batches" of oxide were not equally effective for sulphur removal, even though their iron content was practically the same. Various causes were assigned for this, such as incompletely oxidized iron, burning due to insufficient turning of the mass during rusting, in insufficient watering, and the presence or absence of accelerating agents such as salt, lime, copperas, or secret materials used for their supposed beneficial action. None of these explanations fully account for the great difference in efficiency observed in the tests, where efficiency is based on the actual iron present, and it is, therefore, not affected by the iron content, in fact, only by the state or physical condition of the iron. The first possible explanation of the variation that suggested itself was the water of hydration. Note from Table 1 that this does not explain the observed variation, even in the first fouling, and, what is more important, the great loss of efficiency of some of the samples on the second, third and fourth foulings compared with the first. The proportions and presence of other materials, such as alumina and silica, did not seem to have any particular effect, so it was apparent that purely chemical methods would not reveal the cause of the variation. The subdivision of the oxides was then investigated, as it was thought that some might be in much finer particles. The samples were put through a 200-mesh sieve and retested, with results practically comparable with the original samples. The oxides were then examined under a microscope, microphotographs being made, and very considerable differences in physical characteristics were at once apparent. Sample No. 1 (also No. 2 to some extent) presented a soft, velvety appearance; No. 4 was distinctly crystalline; No. 5 showed not only a crystalline structure, but evidence of fusion. Apparently, then, desirable oxide should be soft and velvety. This suggested a precipitated material, and whether it was not a colloidal precipitate, since ferric hydroxide readily forms a colloidal solution. The ques-

TABLE 1.

Type of Oxide.	No. 1. Precipitated Oxide. Per Cent.	No. 2. Natural Ore. Per Cent.	No. 3. Precipitated Oxide. Per Cent.	No 4. Precipitated Oxide. Per Cent.	No. 5. Pyritic Cinder. Per Cent.	No. 6. Rusted Iron Borings. Per Cent.
Moisture at 105° C	27.79	12.85	6.0	7.28	4.85	1.40
Combined water	5.39	8.55	2.69	4.01	1.36	5.60
Organic matter	2.88	....	2.01	....	0.45 Metallic iron	4.44
Silica	2.25	14.12	7.81	1.63	6.76	....
Alumina	5.75	6.48	12.42	12.69	9.62	....
Titanium oxide	3.59	....	....	....	....	....
Alkalies	1.71	....	....	....	....	....
Undetermined by difference	3.10	1.60	3.15	2.07	3.08 Shavings, etc.	29.63
Iron oxide as Fe_2O_3	47.36	56.40	65.22	72.32	76.90	58.93
Combined water per cent. of oxide	10.2	15.2	4.1	5.5	1.9	9.5
Probable formula	$Fe_2O_3.2H_2O$	$Fe_2O_3(OH)_2$	$Fe_2O_3.H_2O$	$Fe_2O_3.H_2O$	$Fe_2O_3.\frac{1}{2}H_2O$	$Fe_2O_3.2H_2O$
H_2S per unit of iron 1st	48.1	35.3	16.4	3.7	3.6	8.1
H_2S per unit of iron 2d	46.9	6.2	5.0	2.3	2.1	4.7
H_2S per unit of iron 3d	40.1	6.2	5.0	....	....	4.2
H_2S per unit of iron 4th	39.5	4.1	4.99	....	....	3.6

tion thus apparently became one of colloidal chemistry, and so that the following discussion may be more intelligible, we will outline some of the fundamentals of colloidal solutions and precipitates.

The term colloid (from the Greek colla, glue) was used by Graham to distinguish bodies which when in solution did not diffuse through organic membranes like parchment, from those which passed through freely, which he called crystalloids, since in general they were crystalline compounds. Glue, gelatine, agar and gum arabic might be mentioned as colloids. In addition to these organic substances, it was found that many inorganic bodies, generally regarded as insoluble, could, by appropriate means, be brought into what appeared a solution clear to the eye, but which did not diffuse through parchment. These he called colloidal solutions or "sols," to distinguish them from true solutions. If water is the solvent, they are known as "hydrosols." Gold, silver, copper, lead, ferric hydroxids, silicic acid, tungstic acid, and the sulphides of heavy metals are examples of apparently insoluble material that may be brought into colloidal solution. These solutions have certain peculiarities that distinguish them from true solutions aside from their osmotic action.

A. They are precipitated by traces of electrolytes. B, when an intense beam of light is projected through them they usually show a diffuse illumination that is polarized; C, when examined with an ultra-microscope, or with dark field illumination, they usually show the Brownian movement of particles.

Briefly the colloidal condition is a state (not a form) of matter due, to a great extent, to a very fine state of subdivision. Certain optical and mathematical considerations indicate that the maximum size of the particles must be less than the wave length of light, 450 760 millimeters. From work with the ultra microscope and ultra filtration, their sizes have been found to vary from 5 millimeters, the smallest visible with the ultra microscope, up to considerably larger particles, approximating the dimensions of light waves.

Some solutions, when examined with the ultra microscope, do not show particles, but only a diffused light. This may not indicate greater subdivision, but rather the existence of too small a difference between the refractive index of the substance and solvent. Although mere subdivision does not explain all the phenomena of the colloidal state, it seems reasonably certain that the enormous boundary surface thus presented is of fundamental importance.

Colloidal solutions are said to consist of two phases. The dissolved substance is called the "disperse phase," and the solvent the "continuous phase." It is further noted that, for instance, a hydrosol of agar on cooling, possesses a high viscosity, while a hydrosol of ferric hydroxide would exhibit practically no change in viscosity. This has led to a general separation of colloidal solutions into two classes, suspensoids and emulsoids, as they resemble and pass gradually into suspensions and emulsions. In general the organic colloids form solutions belonging to the emulsoids, while the inorganic colloids form suspensoids. We here are primarily interested in the suspensoids, and they may be characterized as a system of two phases, the disperse phase, consisting of solid particles in such a fine state of subdivision that they are no longer affected by gravity, are electrically charged and in a state of constant motion. When a colloidal solution of the suspensoid type is treated with a trace of an electrolyte, the disperse phase forms a "gel;" a "hydrogel" if formed from a hydrosol. The exact physical nature of the disperse phase in the gel state is not known, but it may be assumed as taking on a spongy, honeycomb like structure, and retaining more or less water, depending on the nature of the substance. The gel may be reversible, *i. e.*, may or may not go back into solution. Tungstic and molybdic acids are reversible; silicic acid, stannic acid, ferric hydroxide, are irreversible. In the presence of certain protective colloids, many of the irreversible gels may be made reversible.

On standing, the gels lose water, assuming the pectoid state. Ferric hydroxide in this state is a hard, brittle, blood-colored substance. On further loss of moisture, either spontaneous or on heating, many gels revert to their original crystalline or amorphous form. One notable phenomena in connection with colloidal precipitates or gels, is that known as "adsorption," which is a concentration at the surface, frequently resulting in the removal of considerable quantities of material held in solution when they are brought in contact with the gel. This occurs when any increase in the the concentration of the solution leads to a reduction in its surface tension. This has been gone into theoretically by Willard Gibbs, who derived the law governing the action from thermodynamical bases. This phenomenon, although its name sounds formidable, is a familiar one to us all, and it is due to this action that charcoal absorbs both gases and coloring matter, and is used in clearing sugars and lubricating oils. The use of iron sulphate and lime for clearing domestic water supplies of suspended matter is another example. Tanning leather and some dye stuffs depend upon the same phenomenon. The important feature is the enormous influence exerted by the boundary surface, here it seemed clear that the primary reason for the great efficiency of some of the oxides was the large surface they presented compared to the mass, and that this was due to the fact that they were gels precipitated from a colloidal solution, either of artificial or natural origin. We attempted to determine the adsorptive effect of the different samples in several dyes, but lack of time prevented working out a practical method. As a rough indication of this, the water capacity of equivalent volumes was determined as follows:

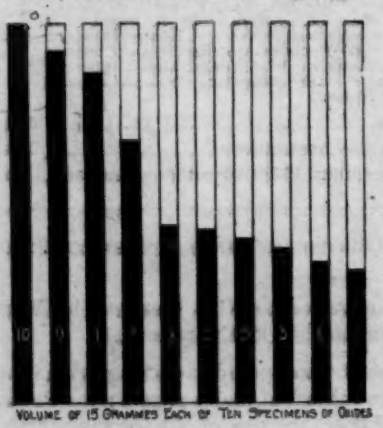


Plate No. 1.

	Water Absorbed Ratio of the Weight of Oxide.
Fe_2O_3 gel	19.0 to 1
Sample No. 1	1.73 to 1
" 2	0.5 to 1
" 3	0.4 to 1
" 4	0.4 to 1
" 5	0.4 to 1
" 6	0.3 to 1

These results were not very accurate, because of the method employed, but they gave some indication of the presence or absence of any considerable quantity of a reversible gel, and they showed in general that, in most of the samples, the gel was almost entirely irreversible, and it probably assumed either the pectoid state or became

TABLE 2.

Sample No.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.
Iron oxide, per cent	47.36	64.00	65.92	72.32	76.90	58.93	....	....	48.58	100.0	100.0	100.0
First fouling	22.8	19.9	10.8	2.7	2.8	4.7	17.8	19.2	13.4	96.3	97.8	30.2
Second fouling	22.2	3.5	3.3	1.7	1.6	5.2	18.4	16.5	12.9	87.0	92.0	....
Third fouling	19.0	3.4	3.3	....	....	3.6	17.9	15.0	12.8	70.0	92.0	....
Fourth fouling	18.7	2.3	3.2	....	....	2.4	16.6	11.4	12.7	60.0	90.0	....
Total H_2S absorbed in 10 foulings	139.1	48.9	48.7	....	....	....	....	....	....	....	....	....
Total H_2S absorbed in 14 foulings	167.0	....	....	....	....	....	....	....	....	....	....	....
Sulphur extracted.....pr. ct.	145.2	....	....	....	....	....	....	....	....	....	....	....
Specific volume 1 gram in cc.	1.45	0.767	0.68	0.58	0.73	0.62	1.156	0.783	1.556	1.667	....	1.17
Weight of 1 cc. in grams	0.6896	1.3	1.47	1.7368	1.3768	1.6032	0.8648	1.2784	0.6432	0.6	....	0.844
Water absorbed times its own weight	1.74	0.5	0.4	0.4	0.4	0.3	1.2	0.6	1.0	....	19.0	....

wholly or partially crystalline. It was felt that, as the gels lost water and became more or less crystalline, the specific volume would probably decrease. The following determinations were, therefore, made:

Colloidal Oxide.

Sample.	Specific Volume.
No. 1	1.45
No. 2	0.767
No. 3	0.68
No. 4	0.58
No. 5	0.73
No. 6	0.62

These results are graphically illustrated on Plate No. 1. It was apparent to us from the work outlined that the nearer it approximates a hydrogel, the more efficient would be the ferric oxide as an agent for the removal of hydrogen sulphide. The problem then became that of preparing the oxide in this form. We have not succeeded in doing this commercially, but it may be interesting to outline some of the experiments made, and to show the appearance of different forms of oxide.

If we take 500 cubic centimeters of boiling, distilled water, and add 5 cubic centimeters of a 33⅓ per cent. solution of ferric chloride, we get a beautiful reddish-brown liquid, a hydrosol of ferric hydroxide. On the addition of a trace of electrolyte, the solution becomes turbid, and a muddy, flocculent gel precipitates. This gel is exceedingly active while moist, absorbing 97.8 per cent. on the first, 92 per cent. on the second, and third fouling, and 90 per cent. on the fourth fouling (No. 11, Table 2), the material being kept constantly in suspension in water. When this gel, after fouling, was allowed to dry and revivify, it rapidly lost water, assuming pectoid condition. On the second fouling it absorbed 87 per cent., the third 70, the fourth 60, indicating a great loss in efficiency, as more and more of it is transformed to the irreversible state (No. 10, Table 2). The micro-photographs show the change in physical appearance of the gel from its original state to the partially crystalline state after drying. Numerous protective colloids were also tried, the first one being colloidal sulphur, formed when the oxide was revivified in suspension. This gave, as mentioned before, an oxide that, on fourth fouling, showed an efficiency of 60 per cent. Some of the artificial oxides, notably the precipitated type, show a considerable percentage of sodium carbonate, and experiments were made in precipitating the oxide from colloidal solutions in the presence of this material, hoping that the sodium, as it crystallized out from the precipitate, on drying would mechanically aid in the protection of the gel structure and prevent the formation of the more compact, semi-crystalline precipitate.

This oxide, however, while quite efficient on the first fouling, rapidly lost its efficiency (No. 8, Table 2). Soap solutions and gelatine were also tried as protective colloids, and while advantageous, the resulting material did not seem to contain any considerable proportion of the reversible gel that had been expected. The micrographs show the results of these experiments.

Other materials were tried, without success, but this work is still going on in the hope that a material may be found which will allow the gel to be dried and handled without too great a proportion of it going over to the irreversible form. The lantern slides (Nos. 10 and 11) will show the difference in the physical character of the oxide when dried with and without a protective colloid (it has been found impossible to reproduce these slides in black and white). It is quite likely that in natural oxides, and to some extent in artificial oxides,

Sample No. 1.

Sample No. 2.

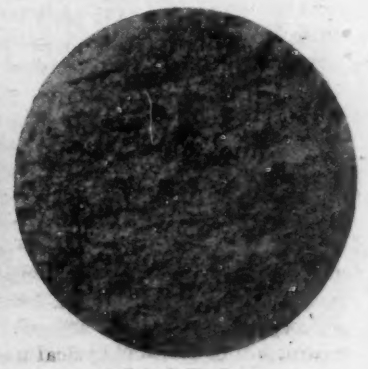
Sample No. 3.

Sample No. 4.

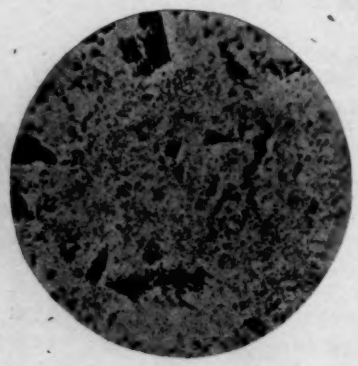
Sample No. 5.

Gel.

Sample No. 6.



Gel Drying.



Gel Dried.

made by rusting iron borings, much of the efficiency is due to the organic matter present acting as a protective colloid, causing a part of the material to form a reversible gel. It is to the absence of such a protective colloid that we attribute the very great difference between the two oxides (Nos. 3 and 4), where the chemical composition is much the same, and yet their action on hydrogen sulphide is so different. In general, we may consider that efficiency of the oxide depends upon the state in which it exists; that the most efficient state is known as a reversible hydrogel, and that it seems impossible to artificially prepare such material without a protective colloid.

In drying the gel, it was found the exact method was of very great importance, and, while we were unable to specify a commercial method that would insure unqualified success, we did definitely determine a considerable improvement could be made in the efficiency of the material; *i. e.*, in retaining a greater percentage of the oxide in the form of a reversible gel, by removing the moisture at the lowest temperature possible.

A material containing any considerable proportion of a reversible hydrogel, will have, both macroscopically and microscopically, a soft velvety texture, and the desirable texture is so apparent that an examination under a medium power microscope, or the feel of it, is all that is necessary to form a very fair idea of its efficiency for the decomposition of hydrogen sulphide. Among other physical characteristics, the efficient oxide will carry a considerable proportion of water, will have a high specific volume, and will contain sufficient combined water to approximate the formula $Fe_2O_3.H_2O$. If we can prepare oxides carrying more than one molecule of water, they will be more efficient than those we have described, not because of the water of hydration, *per se*, but because its presence indicates the existence of a reasonably large proportion of oxide in the form of a reversible hydrogel, the surface of which seems the determining factor. In this connection, attention is called to the micrographs of the surface of a number of samples, an examination of which we believe will bear out the theory that the physical characteristic of the oxide, exemplified in the surface appearance, is the important factor in determining its efficiency.

In connection with the fouling tests described, consider what they may mean in a practical way. Assume two oxides, weighing approximately 50 pounds per bushel, and costing the same initially, one of which will absorb 20 per cent. of its weight of hydrogen sulphide, and the other 5 per cent.; and assume the gas to contain 200 grains of hydrogen sulphide per 100 cubic feet, that it costs 3 cents per bushel to remove, revivify, and replace the oxide. Then if the first oxide had been used 3 times and the second 12 times (which would be required to purify the like number of cubic feet of gas) we find that the cost of purification with the oxide removing 20 per cent. per fouling would be 0.27 cents per 1,000 cubic feet of gas, while that of the oxide removing 5 per cent. per fouling would be 0.48 cents. Solving the practical question, "Will it pay to use this batch again?" is quite easy, by the use of this fouling test in connection with other known data, and in accordance with the following formula: Let—

Average cost of purification ..... = A c. per 1,000
Cost of new oxide ..... = B c. per bush.
Residual value of old oxide..... = C c. per bush.
Cost of removing, revivifying and replacing.... = D c. per bush.
Gas already purified by 1 bushel..... = E cubic feet.
Number of times already used..... = F times.
Average H_2S content per 1,000 cubic feet gas.... = G pounds.
Weight of 1 bushel of oxide..... = H pounds.
Per cent. of H_2S removed by test..... = I
Capital charge per 1,000 cubic feet..... = J c. per 1,000.

Then—

$$A = \frac{(B - C) + (F \times D)}{E} + J.$$

But J is a constant that does not affect this calculation, so we may write it:

$$\text{Operating cost} = (A - J = \frac{(B - C) + (F \times D)}{E}.$$

The question, then, whether or not it will pay to use a batch again with any given absorption test "I," depends upon whether

$$\frac{(B - C) + [(F + I) D]}{E = \frac{H \times I}{G}}$$

is equal to, greater than, or less than the average (A — J.) For the sake of a numerical example let us assume that—

(A — J)..... = 0.3 c.
B..... = 25 c.
C..... = 5 c.
D..... = 3 c.
E..... = 40
F..... = 5
G..... = 0.4 lb.
H..... = 50 lbs.
I..... = 0.2

$$(A - J) = \frac{(25 - 5) + (6 \times 3)}{\left[40 + \frac{50 \times 0.2}{4}\right]} = 0.9 \text{ c. (nearly)};$$

so that using this batch would increase the average cost very greatly. To get the minimum economical percentage that would just equal the average cost, we have

$$I = \frac{G}{[(A - J) \times H]}\left[(B - C) + [(F + I) \times o] - [(A - J) \times E]\right]$$

I = about 7 per cent.

In connection with these calculations, note the inaccuracy that frequently occurs in the common method of rating the volume of gas purified per bushel, by crediting a batch with purifying all of the gas passed while it was in the position of the first box. For example, an oxide recently analyzed was found to contain 4.03 pounds of sulphur per bushel. An examination of the record showed that it had been credited with purifying 71,627 cubic feet of gas, and had it really purified that volume of gas, the gas could not have contained over 40 grains of hydrogen sulphide per 100 cubic feet.

While this method of calculating the work done by the oxide is convenient and may yield average results over a considerable length of time, not being an accurate method, its use will lead to incorrect conclusions. It would be more rational to express the purifying capacity or work done by the oxide in the form of cost per pound of hydrogen sulphide removed per bushel, as in the case mentioned above, the oxide capable of removing 20 per cent. by weight per fouling would remove the hydrogen sulphide at a cost of 0.84 cents per pound per bushel, and the oxide removing 5 per cent per fouling cost 1.7 cents per pound of hydrogen sulphide per bushel. By such figures it would be possible to compare the work of oxides in different plants, the only other data necessary being the hydrogen sulphide in the gas.

It must be understood that these fouling tests do not take into consideration the use of air in continuous revivification, or the fact of clogging of the oxide with increasing back pressure, but both of these factors favor the more efficient oxide.

The most important practical advantage that may be expected from these more efficient forms of oxide is the greatly increased capacity that may be secured with any given installation of boxes. The rate of flow, owing to the more active nature of the oxide, can be increased, practically in proportion with the increase in efficiency. In old works, where the site is already congested, this becomes of very great importance, because it may be possible to care for the increased make expected for 5 or 10 years, without additional capital expenditure, at the same time proportionately reducing the capital charge per 1,000 feet purified. This latter charge is, of course, quite as important as the operating cost, and in many cases approximates it. Where a new plant is to be built, or the in increase is such that we cannot hope to handle it without additional equipment, a more efficient oxide will, of course, reduce the installation cost, but the advantage will not be as marked as in the case of an old plant.

While the ideal method of liquid purification is still in an experimental stage, and, with the exception of a few Continental plants, has not been applied in any large installations, it seems quite pos-

sible that we shall shortly see the development of a successful method of this type. Its great disadvantage heretofore has been the high initial cost of installation with the complexity of control.

Until such time that the successful liquid system shall remove our present purification troubles, we believe careful study, and use of more efficient purifying materials, will well repay the time devoted to these.

[In an Appendix the authors detail a method and plan of determining the quantity of "hydrogen that can be removed" before it has reached the saturating point.—EDS.]

Street Main Standards.[1]

[Prepared for the Eighth Meeting, American Gas Institute, by MR. G. I. VINCENT.]

The object of this paper is to present to the Institute the best practice in street main work, and, in order to ascertain the practice of as many companies as possible, a list of questions was prepared, and sent to 204 companies. From the replies received and from information obtained by correspondence and discussion, the practice, which appears to the writer the best, has been selected. There is necessarily a wide variation in the methods of companies throughout this country, but a study of the data indicates that the variations are not usually due to geographical locations or climatic conditions. In other words, if one best practice can be shown there is no apparent reason why it cannot be adopted by all.

It is proposed to discuss each item briefly and to present a suggestion for standard practice. This is usually drawn from the data received, and if from other sources is so stated.

Cast Iron Material.—Of the replies received 58 per cent. have adopted, or are adopting, the American Gas Institute, 1911 standard, for pipe and specials. Of the remainder, 6 per cent. use American Water Works, 19 per cent. American Gas Light Association (1898), 7 per cent. their own standard and 10 per cent. had no standard. The variations from the recognized standards are most numerous in depth of bell. It is obvious that the American Gas Institute standard has met with universal approval, and no further discussion of it seems necessary.

Specials.—Bell and Spigot Fittings.—Whether all bell-tees and crosses or bell-and-spigot were used, was asked because many adhere to the old practice of using spigot fittings, consequently accumulating a large stock of spigot pieces of pipe. There seems to be no excuse for this practice. Some answer that spigot fittings are used for cut-outs and all-bell fittings for line work. If only bell fittings are carried in the smaller sizes, only one more joint is required for cut-out work than with spigot fittings, and the stock carried is cut in two. The one additional cement joint costs less than carrying the additional stock. For mains 16 inches and over, it is customary to order the fittings as required for a particular job, so the question of stock does not enter.

The suggestion is that, up to and including, 12 inches, all bell fittings will answer for all work and show a saving in the storeroom costs over the slight additional cost of handling cut-out work.

Reducers or Bushings.—Many are still using reducers, although bushings are as good, and cheaper; 16-inch and over may be considered special and ordered as required, while in 12-inch and under stocks would be carried. It is suggested that bushings be substituted for reducers for 12 inches and under.

Full Size or Reducing Fittings.—The question of full size or reduced openings at intersections met with almost universal response that full size openings were left. There is no question that this practice is the better in mains up to 12 inches, and in larger sizes the jobs can be determined separately.

Drip Pots.—The line drip for permanent installation has superceded all other types. A side pot is indicated only in special cases where very large capacity is necessary. The only possible advantage of the side drip is that it can be opened for cleaning or inspection without shutting down the line, but the necessity for this practically never arises in modern distribution practice. The recommendation is that the line pot drip be universally adopted for all sizes, except in special cases.

Size of Pumping Line.—The size of the pumping line from the drip pot varies from ¼ to 1½ inches, the majority using 1 inch. I have adopted 1¼-inch because the pipe is stronger, has thicker walls to resist corrosion and adds very little to the cost of installation. The top of the pumping pipe should be finished with a 1¼ by 1-inch reducer with the 1-inch plug lubricated with heavy oil.

Off set Pumping Pipes.—Those having a large percentage of paved streets use pump pipes running straight up from the drip pot, and those with more unpaved streets use off-set pumping pipes. It is interesting to observe, however, that there are important exceptions to the first rule, and I believe that the pipe run to the curb has a number of advantages over that straight up, under all conditions. The off-set pipe, if in unpaved streets, may be marked by a post at the edge of the parking to facilitate locating in bad weather. If in paved streets, the box is not subject to the wear and tear of a box in the roadway. If settlement takes place, so that the lid rests on the pumping point, no danger would arise, while if in a roadway, a broken pumping pipe or drip pot plug might result. Pumping the drip will not obstruct the roadway by the drip wagon if the pumping point is at the curb. An objection to the off-set pipe is that the drip cannot be "rodded," but the contents of the drip can be obtained by using a pressure gauge. Another disadvantage is that it costs a trifle more than the straight up, and has a greater exposure to corrosion where running under the curb and gutter. I believe the advantages are with the off-set pipe, and suggest it for standard practice.

Pumping Point Cover.—The type of box generally accepted is of cast iron with a square or round loose lid adjustable for length. Fastening the covers with screws is not recommended. After setting the box to grade it should be filled with sand and tar. It is suggested that this cover be standardized and added to the cast iron pipe and special standards.

Valves.—Only 3 companies use street main valves in low pressure, cast iron work, except at bridges or other locations where mains might be broken. There seems to be no need for valves on low pressure mains except in these dangerous locations.

Valve Covers.—The valves should be covered by a substantial iron cover on a brick manhole, to allow access for packing, oiling and testing. Small boxes over active street main valves are not recommended.

Laying.—Location.—The question of position in the roadway was asked to determine if a location at one side of the center of the street was not universally accepted. On account of other underground constructions it is, of course, impossible to suggest a standard location. The practice, however, is to locate the gas mains about 4 feet from curb lines. This applies to the service mains, not necessarily to larger supply mains.

Depth.—The depths at which mains are laid seem to have no general connection with the climate. One reply is characteristic: "Mains are laid 3 feet 6 inches deep, because this is the best location with reference to other underground structures, the frost going down to 7 feet."

While the majority of plants in the South lay mains shallower than those in the North, the reason seems to be that other underground structures were not nearly as extensive as would be found in northern cities of the same size. If it were practicable to lay mains at such a depth, that under no conditions would they be reached by frost, they would be less likely to be broken by strains set up by temperature changes, but this one advantage would scarcely justify the greater depth. One northern city covers its mains 6 feet, and another 6 feet 6 inches, but the majority adhere to 3 feet 6 inches and 4 feet. Lesser depths are undesirable because of the increasing use of deep pavements and heavy paving machinery, and the difficulty of properly grading services to shallow mains. The suggestion is that mains be laid with 3 feet to 3 feet 6 inches cover. This conclusion differs from the opinion given in "Catechism of Central Station Gas Engineering."

Grading.—The question as to grading was evidently not understood, as answers varied from 3 inches in 12 feet to "as near level as possible." A quarter inch in 12 feet will insure satisfactory drainage.

Blocking.—While most companies lay on bare earth, if the miles of main be taken, the advantage is slightly in favor of blocking.

I have discussed this with leading engineers and believe the advantages of blocking are not sufficient to warrant its use as a standard. Careful main laying requires a true bottom to the ditch and in virgin soil the lengths will be supported better than if laid on blocking. Where filled ground or unusual conditions exist blocking alone will not properly support the main.

The above applies without qualification to mains 12 inches and smaller. In larger mains blocking is used to insure satisfactory

1. Slightly abridged.—EDS.

alignment of the heavy lengths, the idea being to take the weight off the joints. If sufficient blocking is used, the expense is justified for mains 16 inches and over, and the following is suggested:

Size Main.	Size of Blocking — Length.	Width.	Thickness.
16-20	24	12	3
24-30	30	12	4
36-48	36	12	4

Two blocks to be laid back of each bell and two in front of each bell.

Protection against Corrosion.—It is not necessary to protect cast iron pipe except in soil known to contain corrosive material, in which case clean clay 6 inches thick completely surrounding the pipe is sufficient protection.

Electrolysis.—Only a very few plants use any method of protection, and these are some methods of bonding. The advantages and disadvantages of this have been discussed by competent engineers and it is not necessary to take up the matter here.

Testing Joints.—Eighty per cent. of the companies test all joints before filling, 9 per cent. test part of their mains, the smaller sizes being passed without, and 11 per cent. do not test at all. Opinions were equally divided as to the merits of air and gas pressure, and on soapsuds or a gauge. One company uses no jointing material except lead wool, and does not test the joints at all. The suggested best practice is as follows:

All joints for low pressure up to and including 12 inches to be tested with soapsuds under the pressure of the gas only; 16 inches and over to be tested with air at 5 pounds, using soapsuds and not depending on a gauge. Cast iron carrying higher than the recognized low pressure to be tested with air and soapsuds at a pressure not less than twice the maximum pressure to be carried.

Bags and Stoppers.—Twenty-three per cent. use bags only, 66 per cent. use bags and stoppers, and 11 per cent. use stoppers exclusively. That stoppers are satisfactory, except some very old imported iron or pipe partly filled with foreign material, is evidenced by the 11 per cent. which have no bags whatever, but this is not offered as standard practice.

Prevention of Freeziug.—The method adopted to prevent freezing on bridges and exposed places is to enlarge the pipe, using two sizes larger than the main. I do not believe this is sufficient in extreme climates unless the gas is dehydrated before reaching the point of exposure. Protective covering is not satisfactory, and the best practice is to enlarge the pipe.

Maximum Tap Hole.—The maximum hole allowed in mains shows a wide variation.

One company taps 4 inch mains as large as 2 inches without a sleeve. From consideration of all answers received the following is offered as best practice:

Size of main	3 In.	4 In.	6 In.	10 In.	8 In.	12	16 In.
Maximum tap hole allowable	¾	1	1¼	1½	2	2	2½

Size of main	20 In.	24 In.	30 In.	36 In.	42 In.	48 In.
Maximum tap hole allowable	3	3	4	4	3	4

In 3-inch mains if the ¾ hole is for a service a split sleeve should be put on. Any hole in a 2-inch main should be subsequently covered by a sleeve. One inch is the largest size allowed for 4 inch pipe, although most companies allow 1¼ inch.

If any larger hole than that given in the schedule is desired split sleeves or the proper fittings are to be used.

Ditching and Filling.—The 7 questions covering digging and filling ditches were to secure information more than with any idea of establishing a standard. The summation of the data is as follows, all applying to soils which can be removed with spades or picks and shovels. Ditching by piece work is satisfactory and economical.

Machine ditching is generally unsatisfactory in urban work. If used at all it should be by contract. If ditches can be filled lightly, as is allowed in the outlying sections of many cities, the most economical method is to tamp around and over the pipe and fill the balance with a scraper. Subsequent flushing of this lightly filled ditch will make a fair job. The reports on machine tamping show it to be satisfactory.

Lead Joints.—Six per cent. of the companies use lead joints, 9 per cent. cement joints and 85 per cent. both.

The schedule given shows the proper depth of cast lead in joints, based on American Gas Institute standard bells.

Size of main	3 In.	4 In.	6 In.	8 In.	10 In.	12 In.	16 In.
Depth of lead	1.5	1.5	1.75	2.00	2.00	2.25	2.25

Size of main	20 In.	24 In.	30 In.	36 In.	42 In.	48 In.
Depth of lead	2.25	2.5	2.5	2.75	2.75	2.75

Lead Wool.—Lead wool is used to some extent by a few gas companies, and the reports are very favorable. The exclusive use of this material by one large company has been mentioned. The theory of the lead wool joint is apparently sound.

Hand or Machine Caulking.—For small jobs the expense of moving a caulking machine is prohibitive. For large mains or long small mains the machine hammer is economical, both in operating cost and in the perfection of the finished work.

Yarn.—Untarred, dry-jute packing, with long fiber and free from grease, is the best material for packing either lead or cement joints.

Cement Joints.—The almost universally accepted method of making cement joints is to drive one rope of packing to the back of the bell with a heavy hammer, then fill the joint with neat cement, properly mixed; drive another rope of packing and point the face of the joint. One variation is to make a joint with a spiral of yarn extending from the back to the front of the bell to hold in place a similar spiral of cement; but it is incredible that this joint could be made tight. Another consists of alternate layers of cement and yarn, which is undesirable because the maximum amount of cement possible should be used in a joint.

Brand of Cement.—A high grade Portland cement may be used. Imported cement seems to have been almost entirely given up. A medium setting cement, rather than a quick or slow setting, is desirable.

Other Jointing Material.—No other jointing materials than lead or cement are used by any of the companies answering.

Lead or Cement.—Lead joints are used by a number of the companies at intersections, at intervals along lines of cement joint mains and on large mains. There is no merit in using lead in the first two cases, but for large mains, many companies are discontinuing cement. The sizes above which lead joints are thought more desirable vary from 8 inches to 30. It is offered as standard practice that cement joints be made only on mains up to and including 12 inches, and that for all over 12 inches either a special bell or a special joint be adopted. The reason for failure of cement joints in the larger sizes seems the joints are not as strong as the pipe. In the smaller sizes mains often break near the bells where the cement joint remained intact. Apparently contraction will not break any gas main, unless aided by some other lateral strain, an unusual condition, or flawed pipe. With a variation of 100° F. in cast iron, the calculated factor of safety against breakage is about 2½, and 100° is at least twice the variation expected in mains. The large mains resist lateral strains better than small mains, but the difference in temperature between the top and bottom of a large main is probably sufficient to set up serious stresses in the joints. To calculate theoretically the stresses to which joints are subjected, due to change in temperature in the mains, I assumed a 30-inch main, with standard A. G. I. bells, laid in Des Moines, Ia., with all possible care, and subjected to temperature underground in that climate.

It was found that the combined shear on the joints, in the straight pull and bending movement, due to changes in temperature and the difference in temperature at the top and bottom of the pipe, was 112 pounds per square inch as a maximum. This is 2½ times the shear allowed in concrete steel work for the maximum safe contact strength of steel and cement. In other words, the shearing stress to which this 30-inch joint would be subjected, due to temperature alone, is excessive, and when other stresses are added, due to forces outside of the main, it would seem an accident if 30-inch cement joints with standard bells remained tight.

The depth of bells necessary to have sufficient shearing strength for the contact between the cement ring and the iron of the bell or spigot was calculated, and the following schedule is offered as the proper depth for bells of the larger size mains when straight cement is used.

Size of main	16-in.	20-in.	24-in.	30-in.	36-in.	42-in.	48-in.
Depth of special bell	5.75	6.25	6.75	7.25	7.25	7.25	7.25

A combined lead and cement joint is used to a large extent in repair and on some new work. It is made by making a cement joint in the usual way; then the cement is trimmed out evenly 1½ inch from the face of the bell. After allowing 24 hours for the cement to set a lead joint is cast on top and caulked, or lead wool caulked in. To repair cement joints cut out the front yarn and the necessary cement, and cast or caulk lead in front of it. This is cheaper than using a special clamp and my experience shows no subsequent leak-

age in the joints so repaired. A possible reason for the efficiency of this joint is that the cement ring holds the joint rigid, or confines its movement to extremely small amounts, and the lead ring has sufficient elasticity to remain tight under the very slight movement. The approximate costs of these joints, and of all lead joints with standard bell and depth of lead, and of all cement joints with the special depth of bell, are as follows:

Size of Main. In.	Lead Wool.		Cast Lead.		Combination Cement and Cast Lead.		Cement with Special Deep Bell.	
	Cost.	Per Cent.	Cost.	Per Cent.	Cost.	Per Cent.	Cost.	Per Cent.
16.....	$2.11	100.0	$1.77	83.8	$1.20	56.9	$0.56	26 6
20.....	3.14	100.0	2.61	83.2	1.72	54.8	0.88	28.0
24.....	4.27	100.0	3.40	79.6	2.21	51.8	1.09	25.6
30.....	5.21	100.0	4.16	79.7	2.70	51.8	1.63	31.2
36.....	6.30	100.0	5.02	79.5	3.26	51.7	2.15	34.1
42.....	7.27	100.0	6.24	86.0	3.79	52.2	2.58	35.5
48.....	8.34	100.0	7.12	85.4	4.36	52.2	3.05	36.5

Notes: The costs are for labor and material only and are approximate. The per cent. columns show the per cent. of the cost of the lead wool joint, which is the highest. Cost of additional iron in the pipe is included in the deep cement joint.

The subject may be summarized (for mains 16 inches and over) as follows:

Cast lead joints in standard bells usually leak slightly in the course of time. Cement joints in standard bells will eventually leak more or less, and the larger the size the greater the leakage. The combined lead-and-cement joint in standard bells has proved satisfactory. The lead wool joint in standard bells has also proved satisfactory. The special deep-bell, all-cement joint may be satisfactory.

I suggest that for low first cost and probable service, the most hopeful combination is the special deep-bell with cement joints, with lead wool in any of the few joints where a standard bell has to be used. Lead joints in small mains in very cold or very hot weather are not necessary, because it is possible to make satisfactory cement joints in any weathers by taking proper precautions.

Clamps.—Where cast iron mains are to be used for pressures up to 5 pounds, the ordinary forms of jointing cannot be depended on. Clamps should be used over the joints, if standard pipe is used, and an asbestos gasket is preferable to rubber.

Steel Material for Street Mains.

Low Pressure Work.—About half the companies use steel pipe for low pressure mains at times, but only for special situations or below certain sizes. The comparative mileage is very small.

Steel or Wrought Iron.—About half the companies specify wrought iron in preference to steel. The so-called wrought pipe is of mild steel. Genuine wrought iron pipe commands a premium of about 15 per cent. over steel, but its additional value is not apparent. Spellerized steel pipe is probably as durable as the wrought iron.

Merchant, or Full Weight.—The leading mills now roll only full card weight pipe, so it is no longer necessary to specify it..

Size.—The smallest cast iron which should be laid under any condition is 4 inches, and any reference to smaller sizes must be understood to refer to mains laid in the past. For smaller than 4 inches, steel pipe should be used, because small cast pipe is too fragile. Two large companies do not lay any cast iron less than 6 inches. Another stops at 8 inches.

Life of Steel Mains.—The life of steel pipe in neutral soils, undisturbed by outside conditions, is as indefinite as cast iron.

Coating.—Five per cent. use Hickenlooper coating, 7 per cent. use asphalt, 12 per cent. red lead and oil, 33 per cent., tar, 9 per cent. various commercial preparations, 2 per cent. galvanized, and 33 per cent. no coating.

It is not believed that any of these coatings give entire satisfaction under all conditions, and opinions from a number of engineers lead to the conclusion that any plastic coating applied by brushing or dipping might profitably be omitted. This question has been the subject of much technical literature, and has come up extensively in the last decade with special reference to coating steel conduits for hydraulic installations, and the lack of conclusion indicates that the matter is far from settled. The coating suggestedby Mr. Von Maur (P. 318, Vol. 6, Part 1, Proceedings Am. Gas Inst.) is superior to any other plastic coverings applied by dipping or brushing. One large pipe manufacturer supplies coatings of this type, consisting of one or more layers of fabric saturated with a bituminous compound wrapped on the pipe. This covering costs about 1 cent per foot per inch of diameter.

Metallurgists say that if the pipe underground can be protected from contact with air, moisture, acid or electrolytic attack, its life will be indefinitely long. The problem is to supply this protection economically. A summary of the methods used to exclude moisture, air and acid from the pipe and their probable relative merit follows:

1. A plastic coating, applied by brushing or dipping. Their value is questionable.

2. A combination of plastic protection and fabric. This covering is superior to the plastic covering, and, if properly and continuously applied, will add materially to the life of the pipe.

3. Plastic coatings subsequently baked on, similar to an enameling process. This type of protection is reported to be satisfactory if it is continuous.

4. Inclosing the pipe in boxing filled with pitch, or a mixture of sand and pitch. This, if properly applied and undisturbed, will afford complete protection.

5. Inclosing the pipe in boxing filled with cement mortar. This is complete protection, if properly applied. It has the advantage over all other types, in that it is practically indestructible.

Fittings.—The best fitting for underground steel pipe is an extra heavy, galvanized, recessed fitting. Standard weight, galvanized, recessed fittings may be satisfactory, but the slight additional cost for extra heavy makes them advisable.

Repair Work.—For repair work standard, cast iron, split sleeves with cement joints are satisfactory.

Sleeves with Rubber Packing.—The few answers received to this question throw doubt on the efficiency of rubber gaskets, and they are, therefore, not recommended. As a substitute, asbestos gaskets are suggested. Their use under the lids of purifiers, and in similar situations, has been satisfactory, and the service is probably as hard under these conditions as in a main.

Pipe Joint Cement.—Thirty-eight per cent. of the companies use red lead and oil, 26 per cent. white lead, 4 per cent. graphite, 4 per cent. Portland cement and oil, 28 per cent. various commercial preparations. For permanent work red lead in linseed oil is suggested as the best.

Depth Laid.—The discussion as to the depth of steel mains follows the same line as for cast iron mains, and the suggestion is, they be laid from 3 feet to 3 feet 6 deep.

Expansion.—No provision for expansion is necessary.

Blocking.—Blocking under normal conditions is unnecessary. For other conditions the specifications for cast iron apply. The additional strength of steel pipe should not be depended on to hold up loose fills.

Testing.—For low pressure work, testing with gas pressure and soapsuds is satisfactory.

Valves.—The use of valves, except in the locations described for cast iron, is unnecessary.

Drips.—The majority of the companies specify a drip made up of pipe and, in the absence of specific descriptions, this is understood to mean a cross set vertically in the line, with a capped pipe in the bottom to form a reservoir and the top outlet with the proper bushing and pumping pipe.

Tapping.—Tapping small steel pipe for service connections is poor practice. When a line is laid, tees looking up should be left for the known services, and the standard street tee and ell used for the connection. For subsequent service connections a tapped cast iron, split sleeve is suggested. The standard saddle used for high pressure taps is usually good.

High Pressure Work—Pipe Lines.

General construction for high pressure is similar to low pressure steel pipe.

Steel or Wrought Iron.—Sixty-four per cent. of the companies specified steel pipe; 36 per cent. wrought iron. Wrought pipe of charcoal iron might be more durable than mild steel, but pipe is not manufactured of this material.

Line Pipe.—Line pipe is used for pipe lines. No companies reporting used extra heavy.

Coating.—Seventeen per cent. of the companies do not coat their pipe; 10 per cent., use the Hickenlooper coating; 14 per cent., asphaltum; 7 per cent., lead and oil; 35 per cent., tar in some form; and 17 per cent., various commercial preparations. One company tests the soil for its corrosive qualities. Suggestions are the same as for steel pipe in low pressure work.

(*Continued on page* 378.)

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NEW YORK, MONDAY, DECEMBER 15, 1913.

BRIEFLY TOLD.

Closing Times, the Philadelphia Convention, N. C. G. A.—The "Gas Meeters" first annual dinner, the night of the 4th inst., was a perfect success. About 800 participated in a good dinner, which was accompanied by the diners' own vocal entertainment. When the waiters had gone, photos of some of the more prominent "Meeters" were shown, then followed a couple of reels of funny French "movies," followed by a half dozen vaudeville acts, with "Will." S. Guitteau as announcer. National Chairman, W. W. Barnes, presided as Toastmaster, and brief speeches were made by Mr. C. Willing Hare, Mr. P. S. Young, Mr. W. H. Gartley, Mr. C. O. Bond and Mr. L. F. Blyler. The morning session of the last day was opened by the reading of the abstracted report of the Committee on the "Development of Industrial Fuel," by Mr. J. S. Welch, Chairman. Full two hours were devoted to this discussion, by representative manufacturers and gas men, which, as Mr. Walton Clark pointed out, dwelt very largely with the engineering aspect of industrial applications. Mr. W. H. Gartley, President of the Institute, expressed his appreciation of the spirit of optimism shown in the sessions, and asked the help of the Association toward making a complete success of the National Gas Congress. Mr. Wrightington presented the report of Committee on President's Address, complimenting Mr. Hare on the results of his term of office and of the outcome of the convention. Mr. Blyler, of Minneapolis, told something of the attractions of the next place of meeting, and the usual formal resolutions were passed thanking the committees and others for their efficient work. Secretary Stotz announced that the final registration figures showed 1,135 members in attendance, 380 guests, and 138 ladies, making a grand total of 1,653. That 164 new members had been enrolled during the week. At 12:35 President Hare declared the formal session adjourned. The afternoon was spent in Exhibition Hall, and the evening was put in at a demonstration of the "manly art." Saturday and Sunday were set aside for Atlantic City. The handsome floor lamp exhibited in the booth of Bayley & Sons was voted to Mrs. A. A. Higgins, wife of the New Business Manager of the Providence (R. I.) Gas Company, she receiving 171 out of 485 votes cast.—Camp.

An Echo of the Happenings in Philadelphia.—A very pleasant happening in the week of the Philadelphia session of the N. C. G. A. was the annual dinner commemorating the eighth anniversary, or "Reunion Gathering" of the "Original Thirteen" members of the National Commercial Gas Association. "Nine-thirteenths" of the veterans responded to dinner call, with appetites none-the-less sharp in that a void (or was it a span?) of eight years intervened between the first and the last. Mr. C. Willing Hare, President of the N.C.G.A., was the guest of honor, and manfully did he withstand the ordeal. Of course, Founder Lucius S. Bigelow occupied the Presidential place, and "L. S. B." certainly did not look that time had been busy in his respect for a minute—to say nothing respecting a few years. To a certainty a most enjoyable evening goes upon the record, and it is well to here remark that it is in such reunions that the spirit of comradeship is kept active to the great benefit of the body in particular and to the industry as a whole. The motto of the "Original 13" is *Semper Fidelis*, and the spirit of its founders is up to the beautiful thought so gloriously conveyed by it.

Failure of Lower Rate Agitation.—In St. Joseph, Mo., the selling price of gas was $1 per 1,000 cubic feet, but for some years the local Company has been supplying natural gas at a much lower figure. Owing to the diminishing pressures in the Kansas fields, from which their supply was drawn, it was necessary to prepare for again making gas, and the city authorities were anxious to secure a rate lower than the old one of $1. The firm of Burns & McDonnell, of Kansas City, was employed by the municipality to make a valuation of the Company's plant and operations, and their report indorses the old rate as fair and reasonable. This price they show would permit a return of only 3¼ per cent. upon the present value of the gas property, with estimated annual gas sales of 300,000,000 cubic feet, and if sales were increased to 360,000,000, a return of 5¼ per cent. The report was accepted by the city and the recommendations followed. Burns & McDonnell have done a great deal of work for municipalities, and they announced that their report would be based on the facts as found. In brief, it was to be the kind of a report which the taxpayer wanted and upon which he could depend. It might not please the politicians and the Gas Company's enemies, but it would save long drawn out litigation, while improvements and extensions waited and the community suffered. The present value of the works was determined as "Reproduction, new, less depreciation." "Going value" was treated logically as part of the cost of reproduction of the works as much as mains, machinery or equipment. The appraisal covered all intangible items, preliminary investigations, organization, legal, promotion, financing, interest during construction, engineering supervision, paving over mains, working capital, etc. As a supplement was an expert accountant's report on operating costs and revenues. The sinking fund method of depreciation was followed where ages were known, and condition depreciation in other cases.

The summarized results were as follows: Total present value, $1,615,478.39, including "going value," $154,163.00; working capital, $45,000.00. Depreciation on all items was $290,041.78, approximately 18 per cent. The report includes a list of 32 cities similarly situated where the average price of gas is $1.10.

December Meeting, New York Section, I. E. S.—The New York Section, I. E. S., held its December meeting, at 8:15 of Thursday evening, the 11th, in the Building of the Engineering Societies, 29 West 39th street. The first topic for the evening was a paper presented by Mr. Frank E. Wallis, whose subject had to do with "The Reasons for Styles in Architecture." The author's presentation was a description of the "Periods of architecture treating of its elements only, without special reference to its application to the question of lighting." A second paper was that by Mr. Howard E. Watkins, whose theme concerned "Periods of Architecture as Applied to Fixture Design." The author treated with the different periods of architecture and their application from an illuminating engineering standpoint. The meeting was preceded by the usual informal *a la carte* dinner, served in Keen's Chop House (70 W. 36th) at 6:15 P.M. of the day named. Chairman W. Cullen Morris' hearty invitation to friends of the members to assist in the deliberations was responded to by many.

CURRENT MENTION.—

The latest advertising output from the offices of the New England Coal and Coke Company, 111 Devonshire street, Boston, is a scratch pad for igniting matches. It is put in shield shape, and so arranged that it may be either "hung" or "tacked" in any suitable or available position. Of course, it carries a good reading "ad.," the tersity of which is even to the point that "he who scratches may read."

"Mr. Allen C. Balch is authority for the statement that the resignations of Messrs. George W. Barnes and W. E. Barrett (respectively as General Manager and Chief Engineer to the Southern California

Gas Company) were prompted by the desire of the former to resume connection with certain Eastern interests, and of the latter's knowledge that the end of his contract period with the Company had expired by limitation." Our correspondent further adds that Mr. Barrett returns to active connection with the sterling concern, the Messrs. J. G. White & Co., of New York; and this we avowedly hope is true. We further understand that a Mr. J. B. Hackstaff, a natural gas expert of Pittsburgh, Pa., replaces Mr. Barnes.

AT the first December meeting of the Dothan (Ala.) City Council the City Clerk was instructed to obtain information from the authorities of Albany, Ga., respecting the cost of constructing the municipal gas plant there, and the manner of its present operation. If the current temper of the Council is any indication of that which is to be done, Dothan will have a gas plant by June 1st.

LAST month the Ladies' Auxiliary of the Babylon (N. Y.) Hospital, the Babylon Electric Light Company and the South Shore Gas Company, of Long Island, as the result of their combined efforts, presented a handsome specimen of the pulmotor for the equipment of the Southside Hospital, Babylon.

WRITING of the Southside of Long Island recalls the fact that, on Wednesday of this week, a special meeting of the taxpayers will be held to consider the question of granting a franchise to the Long Island Lighting Company to lay gas mains and to maintain, "operate and extend a supply of gas" to the residents of Northport. The applicants ask for a 50-year grant, and they agree to be bound by these provisions: Not to charge in excess of $1.60 per 1,000; the prompt payment of accounts to make operative a rebate of 10 cents per 1,000; the quality of the gas supplied to be 20-candle power, maximum, or 18 candles, minimum; the Town Hall to be supplied with gas, and not charged therefor.

MR. THOMAS JONES YORKE, for many years a prominent resident of Salem, N. J., died at his home there the morning of the 3d inst. Deceased was President of the Salem Gas Light Company, succeeding the late Martin P. Gray, once Vice-Chancellor of the State. He was President of the Fenwick Club, had served several terms as President of the Salem Country Club, and had been prominently identified with the proceedings of the Common Council.

MR. ROBERT W. GOODNOW, Assessor and Collector of Water Rates for Kansas City, Mo., has compiled, at the instance of the Board of Fire and Water Commissioners of the named city, a handy booklet (vest pocket edition) giving explicit directions to the users of water, gas and electric meters concerning how to "read" these measurers. The directions (which are cleverly illustrated) are very explicit, the primer lessons being in language so plain and so easily remembered that a dullard indeed would he be who could not read the dial figures and make the necessary extensions and findings almost without mental effort. In fact, the whole thing is as close to automatics as are the Burroughs' calculating machines. The booklets are for free distribution.

ONE of the latest doings by the commercial division (the force thereof is constantly getting out something new and of merit) is the issuance of a circular, which is a reproduction of a large advertisement that the Company often carries in the Baltimore newspapers. The "ad." declares that the Company operates a repair and refinishing shop for causing old gas fixtures to take on the charm of newness, with the complete restoration thereto of all activities. The rates at which these jobs are done are given on the circular, and the tabulation is so instructive that we herewith reproduce it—its title is, "Prices for Refinishing Gas Fixtures:"

Finish.	Two-Light.	Three-Light.	Four-Light.	Five-Light.
Polished brass.....	$1.50	$1.75	$2.00	Estimates
Brushed brass.....	1.50	1.75	2.00	cheer-
Polished copper...	1.65	2.00	2.25	fully
Mottled copper....	1.65	2.00	2.25	given
Oxidized copper...	1.65	2.00	2.25	on
Gun metal.....	1.65	2.00	2.25	request.

This schedule includes the cost of removal of fixture to the Company's shop, the installation of a temporary fixture while the regular fixture is being repaired, and also the reinstallation of the unfinished fixture.

MR. J. G. WHITE, the active, well-balanced, gentleman at the head of the famous J. G. White Engineering Corporation of this city, was warmly received at headquarters (43 Exchange Place) on his return from a six months' sojourn abroad, both in England and on the Continent. The journey home was made aboard the *Olympic*, which vessel docked here last Wednesday. The energetic gentleman is said to have "sojourned," but his stay was not of the sort that usually goes with a "sojourn." He was in fact a busy man all the time, the major portion of which period was spent in the London Home Office of J. G. White & Company, Limited, of which corporation he is President. One of the important recent financial undertakings of that vigorous concern is the formation of the International Light and Power Company, Limited, a holding company in several light and tramway properties throughout South America.

A FITTING climax to the way in which the authorities of the Oak Park suburb of Chicago have all along howled the question of establishing a gas rate for the mentioned section had a fitting climax, when, at a secret session, the Village Board adopted an ordinance putting the rate at 80 cents per 1,000. The ordinance is to become nominally effective to-day, but it should go without saying that the measure will be practically inoperative for many a day. Secret session "orders" are far from being either wholly American or free from taint of injustice.

MR. JOHN APTHORP SWEETSER, President of the Lexington (Mass.) Gas-Electric Company, died suddenly, in the railroad station, South Framingham, Mass, the morning of the 8th inst. Deceased was born in Newburyport, Mass., December 20th, 1838, and some years thereafter settled in Grafton, Mass., in the affairs of which he eventually became a prominent figure. In 1901 he removed to Lexington, where he had large business interests. He was a member of the Prudential Committee, the Hancock Congregational Church.

ON the evening of Friday, the 5th inst., Mr. and Mrs. C. Henry Irwin (the former is Treasurer, the Consolidated Gas Company, Long Branch, N. J.), were the hosts at an elaborate shore dinner, tendered by them to Mr. Dean W. Flowers, General Superintendent of the named corporation, who was about to resign that charge in order to assume the Superintendent's post in the operation of the St Paul (Minn.) Gas Light Company. The occasion was a thoroughly pleasing one; furthermore, it convincingly demonstrated the hold that the guests of honor had on the affections of not only their social intimates but of their business associates as well. The instance also affords testimony to the valuation put upon his services by a former ranking officer, for at one time Col. Paul Doty, General Manager of the St. Paul corporation, and Mr. Flowers were in very close business relation, when the former was in charge of the Long Branch Company's trading as Chief of Staff.

AT last the proprietors of the Portland (Ore.) Gas Company are preparing to determine just what rights they have under their charter from the city to use the sub-surface of the highways for the placing of pipes therein, the co-related question being whether or not contractors working on city account can select excavating lines irrespective of the propinquity of the gas carriers. An action has been brought by the Company to restrain Glebisch & Joplin from digging sewer trenches so close to the gas mains as to imperil the latter. In the complaint the Company avers that, up to the 3d inst., the damage caused on this account amounted to $1,500, and that at least an equal sum would be lost were the contractors allowed to continue as they are proposing. The gas mains are buried to a depth of 5 feet, the sewer trench cover being 20 feet deep, and the width 12 feet. In many instances these lines are excavated less than 4 feet from the gas lines, whereas it was always possible to have the sewer trenches lined up at least 12 feet from any gas mains.

THE Kewanee (Ills.) Light and Power Company has announced that, beginning the first prox., the rate for gas supplied from its Galva (Ills.) division will be $1.25 per 1,000 cubic feet, a concession of 5 cents.

MESSRS. HODENPYL, HARDY & CO., of New York, have opened offices in Chicago.

THE California State Insane Asylum, in Stockton, which maintains a yearly average of 300 patients, has authorized the Western States Gas and Electric Company to equip its kitchen for cooking by gas.

MESSRS. H. M. BYLLESSBY & CO., from their Chicago headquarters, report that: "Electric and gas connected load figures from all of the Byllesby properties show appreciable gains, as of October first compared with the year before. These properties are now serving 212,000 consumers." The gain in gas output averaged 6¼ per cent.

(*Continued from page* 375.)

Couplings.—Standard, recessed couplings for line pipe are recommended.

Fittings.—Extra heavy, galvanized, recessed fittings are recommended.

Pipe Joint Cement.—Red lead and oil mixture is used by 43 per cent. of the companies; 26 per cent. use white lead; 8 per cent. cement and oil; 11 per cent. graphite; 9 per cent. various commercial products; and 3 per cent. none at all. Red lead is suggested as the best.

Maximum Pressure on Cast Iron Mains.—The highest pressure carried on cast iron mains by any company is 12 pounds. There seems to be no reason why higher pressures should not be carried if the joints can be made tight.

Expansion Sleeves.—Although 74 per cent. of the companies use expansion joints there is no good reason for their use except in exposed mains subjected to a wide change in temperature. In underground work they are not necessary, as the lines have an ample factor of safety with a range of temperature of 50°. The cases of lines pulling apart at couplings or fittings are believed due either to the fact that recessed fittings were not used so that severe corrosion took place at the exposed thread, or that the threads were improperly cut. Tapered threads carefully cut should always be used.

Location of Valves.—Nearly all the companies use valves, at intervals of from 500 feet to a mile. Under normal conditions it is suggested that intervals of 1 mile are sufficiently close.

Type of Valves.—An all-iron, double gate, inside screw-valve, with recessed screw-hub is recommended.

Leaking Valves.—Many companies report trouble from leaking valves. Two leading companies install two valves at each valve location so that it is necessary to shut off only one section of a valve. The principal trouble is accumulation in the bottoms of the valves prevent their closing tight.

It is suggested that two valves be installed at each location, in a brick manhole, so that access may be had to the valves at any time.

Depth Laid.—Pipe lines are laid almost universally at a depth of from 2 feet to 2 feet 6 inches, and this depth is suggested as satisfactory.

Testing.—Lines should be subjected to an air pressure twice the maximum pressure at which the line is to be operated, and all coup lings and fittings tested with soapsuds. A gauge to show drop in pressure will not detect small leaks unless the pressure is allowed to remain on for an unreasonable time. For example, a mile of 3-inch line, pumped to 100 pounds pressure, and leaking 2 feet an hour, will only drop 3 pounds in 24 hours, while a fall in temperature of 15° will cause an equal drop.

Drips.—The majority of the companies do not use any drips on high pressure lines, moisture eliminators at the outlet of the pumping plant removing all moisture. It is suggested, however, that tees be installed at the low points on all pumping lines, and marked by suitable permanent monuments or property corners.

Pressure Carried.—The pressures carried vary from 5 pounds to 75 pounds, with a tendency to increasing.

Leaks Fixed, How?—The accepted method is to cover the leaking fitting with a split leak clamp made for the purpose. Where only the thread is leaking a satisfactory repair can be made by caulking copper wire into the recess and peening over the bead of the fitting.

Marking Valves.—Even where the valves are covered with manholes there is a possibility of their being hidden by shifting traffic, particularly in unpaved roads. The suggested method of marking is by a post of 4-inch cast iron pipe set in the fence line or other suitable location.

High Pressure Town Lines.

Reducing Governors.—In the larger systems of distribution the earlier practice was to reduce the pressure on the town lines to holder pressures. This was done by discharging into a holder and distributing from it. In the evolution of the system, district governors were installed in place of holders, still delivering holder pressure. Later, they set the district governors at 2 or 3 pounds and equipped the consumers with governors. At present numerous towns carry full line pressure. All objections to this system have been met and it is entirely safe and satisfactory. The advantages, however, are not enough to warrant its recommendation for universal adoption.

In the operation of a high pressure system, consisting of pipe lines with towns at intervals, the use of district governors with safety blow offs makes it possible to omit the blow-offs on individual services in the towns, if the pressure carried in the towns is not over 2 pounds. The advantage of low main installation cost and uniform service to consumers is then obtained without the individual safety seals and the slight additional hazard by carrying full line pressure up to the consumers' premises. The requirements for peak load storage can be met by high pressure storage tanks adjacent to the towns.

Pressure on Town Lines.—The suggested practice is to carry a maximum of 2 pounds on town lines. Scattered villages and hamlets may be served at full line pressure.

General Valve System.—Some engineers say that frequent valves are required on town lines under 2 p unds pressure, and others that practically no valves are required under 20 or 25 pounds pressure. The necessity for valves is to isolate sections of the town in order to make repairs. It is suggested that, where the full line pressure is carried on the town lines, the same system of valves be used as on the pipe line, so that any mile of main can be isolated. Where the town is taken under moderate pressure of 2 pounds, as heretofore suggested, it is not necessary to use valves except for special locations.

Tapping for Services.—The universal practice for making service connections to high pressure mains is to use a saddle with a lead gasket. The service can then be run from a corporation cock on the high pressure or with the ordinary fittings on the 2 pound main.

Service Shut-Offs.—It is suggested that service shut-offs be installed outside the building on high pressure services, whether the pressure is 2 pounds or 30 pounds.

Special Safety Precautions.—Where the towns are taken on full line pressure all consumers, and all consumers along the lines, should be provided with safety seals having blow-offs of ample size, fully protected against stoppage.

General Policy.

Overhauling ahead of Paving.—It is universal practice to overhaul or make some special inspection of mains on streets about to be paved. To what extent this should be carried can scarcely be standardized, but it is suggested that all mains to be covered with paving should be barred over, and all services and drips be examined.

Minimum Size under Paving.—It is suggested that no cast iron mains smaller than 4 inches be allowed to remain under paving under any circumstances. If 2-inch or 3-inch cast iron mains are in streets about to be paved, it would be the usual practice to replace with not less than 6-inch. Any 4-inch mains allowed to remain under paving should be examined for service taps, and sleeves put on any taps larger than 1 inch.

Main Inspection.—All the larger companies make some inspection of their mains. The range is from the continuous daily line walking, down to a periodical inspection of specific locations. One company reports monthly inspection of all mains on bridges or other exposed places. Another periodically inspects where leakages might cause damage, as around green houses.

It is not possible to standardize this practice, but, as an example, the procedure of one works of moderate size is suggestive. This company inspects all hazardous places such as exposed mains and bridge crossings, including the valve controls, every 3 months. Once a year a complete inspection of the main system is made. This is in the late fall, and includes an inspection of ditches over services of the past season, to make sure that the underground structures, both new and old, are in good condition as far as surface indications will show.

Special Inspection of High Pressure Mains.—It is suggested that a continuous patrol of high pressure pipe lines is advisable. The larger companies patrol their lines daily.

Where high pressure is carried into the towns, the mains should receive the same attention as the pipe lines. Where reduced to moderate pressure the same attention should be given as to low pressure installations.

Test for Leaks.—The last two questions under general policy were not clearly understood, and the returns were so few that the discussion is omitted. The tests for leakage by observing the drop in pressure in a long high pressure pipe line would not be satisfactory unless the leakage were so large that it would probably be discovered without the test.

Conclusion.

When the writer took up the work of digesting the data submitted by the various companies he doubted whether the information would be of sufficient value and interest to make its preparation worth the effort. It seemed likely that the practice in the larger companies would be so alike that there could be little choice, and that few new ideas would be brought out.

As the preparation proceeded this was not found to be the case.

The paper is at best but a discussion of the data submitted, for there was not sufficient time to take up, by correspondence or otherwise, any practice of unique interest submitted, except in a very few instances, but it is hoped that more will be brought out in the discussion.

In conclusion I offer the opinion that: First, it is entirely possible to standardize street main practice; second, that such standards would be of value to all gas companies regardless of size or geographical location; third, that if it is decided to continue the work it can best be done by a committee of the Institute.

Faults in Incandescent Burners.

A special contributor of *The Gas World* tells in that publication the following story connected with the heading:

It may be of interest to briefly detail the faults which have converted otherwise good burners into hopeless failures, but with no intention of attempting to explain how to design a burner. as the latter is far too intricate.

Referring particularly to the inverted type, the essential parts of the burner are the nipple, air chamber, throat (in many burners this is dispensed with), mixing tube and nozzle. Many burners are spoiled by the jet of gas from the nipple impinging on the side of the mixing tube, with resulting poor air injection, and probably a jumpy flame. This is especially the case where a regulator is used, as frequently the needle is not true in the hole, and as it is rotated or reciprocated the jet of gas is delivered toward the walls of the tube. It is most important at pressures of from 15 to 25-tenths, the nipple should be dead true.

Another feature that bears on the action of the nipple is, the effect of the shape of the burner upon the flame. Broadly speaking, there are three types of burners, the vertical, the angle, and the inverted. I find that a more steady, quiet flame is obtained from the angle or inverted burner than from the vertical, because the mixing is better with the former types, the reversal of the direction of flow of the gas and air more thoroughly mixing them. As, owing to the shape of the casing, which is a governing factor in domestic burners, a short mixing tube is often used, the mixing is frequently very poor in this type of burner, the gas and air coming through in layers; and as this causes the inner cone to vary in length, the burner is noisy and the light unsteady. One maker has adopted the practice of making the stream of gas impinge on the side of the mixing tube in his vertical burners, with the object of setting up eddies in the tube, and so assisting the mixing, but it is not effective. Other makers fit gauzes and baffles, which are much more effective, but in some cases the baffling is carried to such a point that it is impossible to obtain a well aërated flame at reasonably low pressures.

Two of the foregoing statements may appear contradictory, viz., that the gas stream must not impinge on the side of the tube, and that the angle burner or inverted burner are the more effective types, though the mixture must impinge somewhere in these burners When the gas has done its work of drawing in air, the impinging is not injurious, provided it is not overdone. That is to say, straight tube must be provided to ensure good injection, and then the gas and air may be baffled to give a good mixture. And a gauze in the nozzle is very useful in assisting the mixing. Although the throat of the injector is a most important feature, it is dispensed with in many burners, and a piece of tube with a ragged end, screwed or rolled into the air chamber, serves as throat and mixing tube. It is not surprising that such burners are inefficient and noisy.

For a burner to give the best results with varying pressures, it is essential that regard be paid to the shape, size and finish of the throat. Beyond the throat, the tube should be widened out to reduce the velocity and allow of the gas and air mixing thoroughly. It is here that the makers are particularly fond of putting in ledges and sudden reductions of area. I know one burner, in which, by the introduction of a suitable throat, and the removal of an obstruction in the tube, the candle power was raised from 630 to 1,150, and the consumption from 11 cubic feet to 13¼ cubic feet; *i. e.*, the efficiency raised from 57 to 87 candles per foot. The importance of a smooth, clean tube is obvious from this.

As to nozzles, there is, generally speaking, very little of which to complain. Some of the cheaper burners with brass nozzles have the distance from lugs to tip of nozzle too short, but most burners have passable nozzles. Even though the burner proper is correctly proportioned and well made, it is quite common to find it spoiled by products of combustion being drawn in at the air mixer, reducing the flame temperature, making the flame unsteady. Burners are frequently seen in which the products are deflected but an inch or so from the air inlet, and the efficiency of these is invariably low. By fitting larger deflectors, it is possible to considerably raise the efficiency and obtain a more steady flame. Makers have a great deal yet to do in improving domestic burners. Of course, one cannot expect much of a burner for 25 cents, but some high priced burners embody one or more of these defects. There are cheap lamps on the market which look fairly well, but when put on the photometer are lacking in illuminating power. It is not easy to tell by looking at a lamp whether the efficiency is high or low; what the average man would call "good," may be anything from 30 to 40 candles per cubic foot. It is not, therefore, sufficient to say of a cheap lamp that it looks about as well as a more expensive one; the photometer will surely tell a different tale.

Many lamps are spoiled, when fitted with a glass bulb, by having the holes in the bulb in the wrong position relative to the mantle, causing cold air entering through the holes to impinge upon the mantle, giving a dark streak at such points. The position of the mantle relative to the fixing screws on the gallery is an important point frequently overlooked, the mantle generally being too low to make the best use of the reflector or shade. Some fixtures for semi-indirect lighting are very badly designed from the illuminating point of view. They are suspended too far from the ceiling, so that what is really obtained is a very inefficient form of direct lighting. Then, again, using the inverted burner, the bulk of the light is thrown in a downward direction. just where it is least desired, for the reason that it needs a double reflection, with loss, to get it as indirect light. The upright mantle, or a mixture of upright and inverted mantles, is better for indirect, or semi indirect lighting, as the major portion of the light is thrown in an upward direction, where it is wanted. It is desirable with such fittings using gas that an enamelled or porcelain reflector be used, as the ceiling will soon cease to properly perform its duty of reflecting the light downwards.

The writer's definition of a good burner or lamp is one which will give a well aërated and steady flame at all ordinary pressures and with a wide range of qualities of gas, which is accessible, and has a long life. Many lamps and burners will not meet that specification, chiefly owing to lack of attention to detail. The makers will tell you that detail is expensive, but money spent on detail is repaid by higher efficiency, longer life and satisfied consumers.

Government Classification of Coals.

The classifying of coals, according to the relative hardness, etc., is arbitrary and unreliable: but being common, and in the absence of a better plan, it is used by the Geological Survey. The grades generally recognized in the United States are: Anthracite, semi-anthracite, semi-bituminous, bituminous, sub-bituminous and lignite.

Anthracite coal is generally defined as a hard coal, having a fuel ratio (fixed carbon divided by volatile matter) of not less than 10. Most of this coal comes from the anthracite field of eastern Pennsylvania, but there are small areas in some of the Western States where the coal has been changed to anthracite by the heat and pressure of masses of igneous rock.

Semi-anthracite, having a fuel ratio of from 6 to 10, is found in only small amount in the United States, in local basins or in close proximity to igneous rocks.

Semi-bituminous coal is of great commercial importance but not widely distributed. It has a fuel ratio of from 3 to 6, is the best steam coal in the country, and some of it can be coked. Its centers of production are the Pocahontas and New River fields of Virginia and West Virginia, the Georges Creek of Maryland, the Clearfield of Pennsylvania, and the Arkansas field in the vicinity of Fort Smith.

Bituminous coal is the most important and includes most of the coals east of the Rocky Mountains. In the Western States the large areas of bituminous coal are the Trinidad Raton field of Colorado and New Mexico; the Grand Hogback of Colorado; the Book Cliffs of Utah; Rock Springs, Kemmerer and Black Hills of Wyoming; the Great Falls field of Montana; and some districts of Washington. This grade furnishes most of the coking coal of the country, and is largely sold for steam and domestic uses.

The term sub-bituminous has been adopted for what is generally called black lignite. The latter term is objectionable because the coal

is not lignitic in the sense of being woody, and the name seemed to imply that it is little better than the brown, woody lignite, whereas many of these coals closely approach low grade bituminous. In fact, it is extremely difficult to separate this class from those immediately below and above it. It is generally distinguished from the lignite by its color and freedom from woody texture, and from bituminous coal by the slacking it undergoes when exposed to the weather. As the latter is an important difference commercially, it has been adopted as a criterion for the separation of sub-bituminous and bituminous coals.

This coal is found in most of the Western fields, especially about Boulder and Denver and North Park, Col.; Gallup, N. M.; Hanna, Douglas, Sheridan and Bighorn Basin, Wyo.; Red Lodge and Musselshell, Mont.; and in Washington and Oregon.

Lignite as used by the Survey is restricted to coals distinctively brown and generally woody. They are intermediate between peats and semi-bituminous coals, and are abundant in Montana, North Dakota, northern South Dakota; and found to some extent in all the Gulf States.

Producer Gas Engines in Coal Barges.

A fleet of 15 self-propelled barges, to ply between New Orleans and the coal fields of Northern Alabama, is of peculiar interest in that they are the first craft of their kind in America to be propelled by producer gas.

The barges are of steel, and similar in design to those used on the canals of Holland. Their measurements are: Length, 240 feet; width, 32 feet; depth, 8 feet; and their capacity 1,000 tons. They are propelled by twin screws and have a speed of approximately 7 miles an hour when fully loaded, weighing close to 240 tons. The screws are driven at 300 R.P.M. by two 75-horse power vertical gas engines, the gas furnished by a 150-horse power producer. The fuel used is the heretofore waste coke from the ovens of the Birmingham district, which consequently is secured at a very low price. This coke is practically pea size, of a calorific value of about 11,000 B.T.U., and the consumption is approximately 1 pound per horse power hour. Each producer is equipped with scrubber, tar extractor and gas tank, and has a water bottom.

The auxiliary power equipment consists of a 9-horse power gasoline engine, which drives a centrifugal pump for the ballast and bilge water, a blower, an air compressor and a 5½ k.w. direct current generator. Current is used for electric lights throughout the boat, fans in cabins and engine room, a 3,200-candle power search light and a 5-horse power motor for operating an anchor winch. The generator is so mounted that when the large engines are running it may be belt driven from one of them. A second 4-inch centrifugal pump is also installed to be driven by one of the large engines through friction wheel contact.

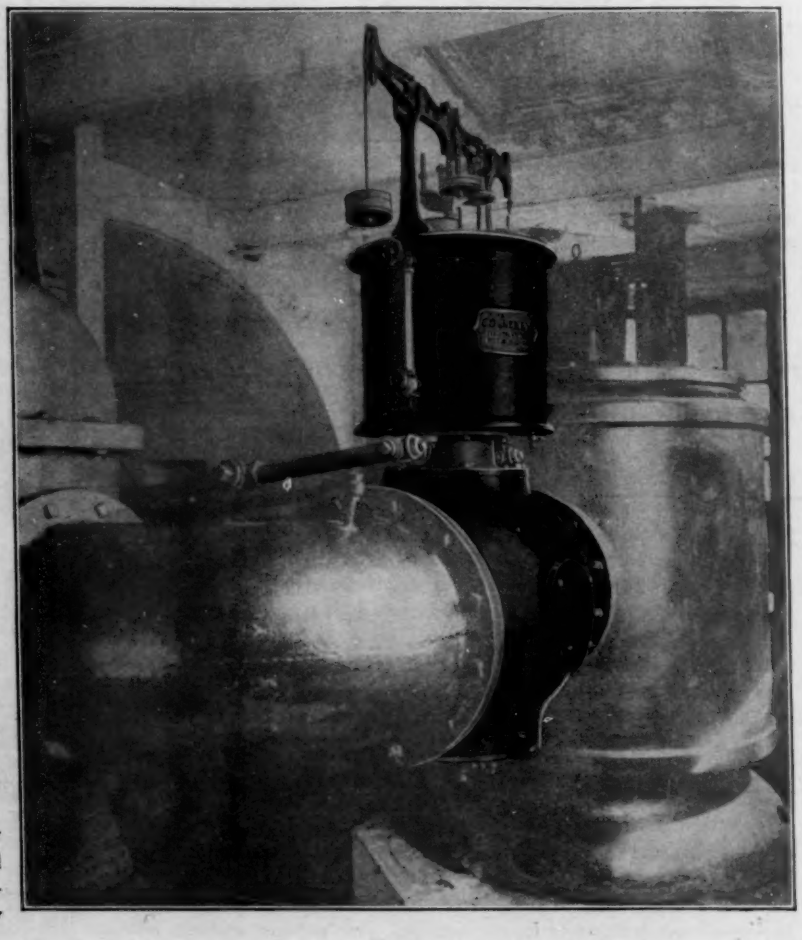
A decided advantage of the self-propelled barge for use in these waters is that they can negotiate the numerous locks of the Warrior and Tombigbee rivers in much less time than if towed; a lock being passed in 20 minutes by these vessels, whereas more than an hour would be consumed by a towed barge.

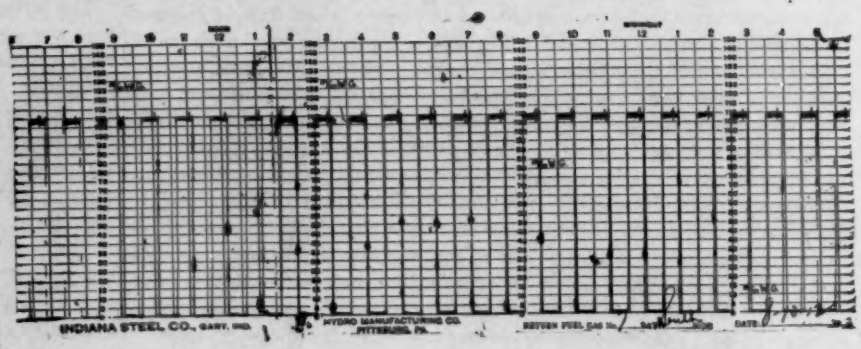
The barges will make the trip to New Orleans in 72 hours and with all 15 vessels in service it is estimated that coal will be moved into New Orleans at the rate of 50,000 tons a month. Added revenue will be derived by carrying freight on the return trip.

New Methods and Appliances.

Fuel-Gas Regulation, on a Mammoth Scale.—Again does the Connelly Iron Sponge and Governor Company deserve to be congratulated over an achievement in the line of fuel-gas regulation on really a mammoth scale, which is being done in the huge plant of the Koppers' Coke Oven type, in the wonderful works' aggregation of the Indiana Steel Corporation, Gary, Ind.

The illustration herewith shows one of the eight governing units installed by the Connelly Company, each of which takes care of all the gas used under one of the batteries, each comprising 70 ovens,





and consuming between 6 and 7 millions cubic feet of gas per diem, or a total of 48 to 56 millions cubic feet for the entire plant of 8 batteries, carrying 560 ovens.

The sensitiveness of these governors will be the better appreciated when it is said that the pressure on the governor outlet is constantly maintained with a variation not to exceed 3 millimeters, even though the gas be turned off totally, and renewed quickly when the flow is reversed from one side to the other of the battery—the burners heating the ovens on one side being mechanically closed the same moment, and, immediately following the complete closure, the burners on the other side are mechanically opened. The governors, therefore, must respond instantaneously to prevent an increase of pressure on the lines when the consumption is cut off, and, to prevent a drop in pressure, when the heavy pull comes on, both of which actions happen within a period of 30 seconds; and as the inlet pressure to the governors varies considerably, the close regulation that is accomplished is naturally all the more difficult and noteworthy.

The accompanying chart shows graphically the operation and working of the governors. The gauge line, from one side of the battery only, was cut off with the reversal, which explains the ½-hour gaps of no pressure registered on the chart. These instruments (in continuous operation for about 2 years) have given perfect satisfaction in every way.

Uses for Coke Oven Gas.—At the Brussels meeting, the Iron and Steel Institute, Mr. E. Coppèe read a paper on "The Manufacture of Coke in Belgium." After thoroughly covering the development of the retort oven, he gave detailed descriptions of the Coppèe and

Semet-Solvay systems, which are the types most used in that country, and noted the many different applications for the products of the process. He noted that the most profitable development in the use of surplus gas was its application to town lighting. The transporting of gas under high pressure had been so perfected that it now presented no greater difficulties than the moving of water. The old bat's-wing burner had been almost entirely superseded by incandescent lights, so the candle power of the gas supply was of minor importance—only calorific power need be considered; but the ordinary surplus gas from coke ovens scarcely reached a high enough standard in this respect.

For lighting purposes a gas should have a calorific power of at least 560 B.T.U.'s per cubic foot, and oven gas was very seldom as rich as that, requiring carbureting with benzol or mineral oil to bring it up in calorific power. To avoid the expense of carbureting, the usual process was to fractionate the gas from the ovens.

The gas given off during the process of distillation in a coke oven was not uniform. Its calorific power gradually increased from the commencement of the distillation until a maximum was reached, and then got poorer; the average calorific power of the gas evolved between the 3d and 18th hours was more than 560 B.T.U. By dividing the gas from the ovens into two portions, it was possible to use the richer for lighting, and the other portion for heating the ovens; and any surplus could be used in gas engines or for other purpose.

The proportion of lighting gas depended upon the quality of the coal. At Ressaix, for instance, they were coking a poor coal, judged by English standards, containing only 18 to 19 per cent. of volatile matter, and under 9,400 cubic feet of gas per ton. The yield of gas of 560 B.T.U. and upwards was about 4,050 cubic feet per ton, or 43 per cent. of the whole. Results in this field showed conclusively that lighting gas could be made simultaneously with the production of metallurgical coke, and they might expect to see very large developments on these lines in the near future.

America and Germany were the first countries to take this up to any large extent, and at present Germany has 45 towns wholly or partly supplied with gas from coke ovens. They were also taking up the question in Belgium, and arrangements had been made for lighting Liége, Ghent, Mons, Ostend, one of the suburbs of Brussels, and other places. Surplus gas could, therefore, be looked upon as an important and valuable by-product, and its utilization on the above lines would further contribute to profits and reduce the cost of coke.

This table had been prepared to show the costs of coke under various stages of development of the coke oven, assuming that the plant in Belgium produced 1,500 tons of coke per week from coal of about 20 per cent. volatile matter, costing $2.35 per ton delivered at the ovens, wages and other expenses being taken as equal in each case:

Per Ton of Coke.	Beehive Oven.		Non-By-Product Retort Oven.	Waste Heat By-Product Oven.	Regenerative By-Product Oven.	
Yield of coke.....	68 per cent.		77	80	80	
Cost of coal.....	$3.50		$3.15	$3.00	$3.00	
Wages, upkeep, sinking fund and general expenses.....	0.47		0.37	0.43	0.43	
Total.....	$3.97		$3.52	$3.43	$3.43	
Credits: Value of by-products.	Hot Gases not Used for Steam Raising.	Using Hot Gases for Steam Raising.				
Value of steam.....	....	0.29	0.39	0.30		
Value of surplus gas						
(a) for lighting...	....	....	....	....	$0.90	$0.66
(b) for power.....	....	....	....	....	....	....
Profit on by-products	....	....	....	0.60	0.60	0.60
Cost price of 1 ton of coke	3.97	3.58	3.58	2.52	1.93	2.23

In calculating the above it had been assumed that the surplus gas could be sold for lighting at a price equal to .17 per 1,000 cubic feet, after deducting the cost of purifying.

The carbonization of coal, at one time carried out with the sole object of producing coke, was now accompanied by the making of other products of great value, and in a modern coking plant where the surplus gas was sold for lighting or used for power production, coke no longer, properly speaking, was the principal product manufactured.

THE STROMMENGER PROCESS FOR DIRECT RECOVERY OF TAR AND AMMONIA.—At the Phœnix Colliery Company's coke oven plant (Ruhrort, Germany) this process is used to remove the tar and ammonia without distilling. For completely removing the tar, before the gas goes to the saturator, a tar wash-extractor is used (shown in elevation in Fig. 1, and in section in Figs. 2 and 3).

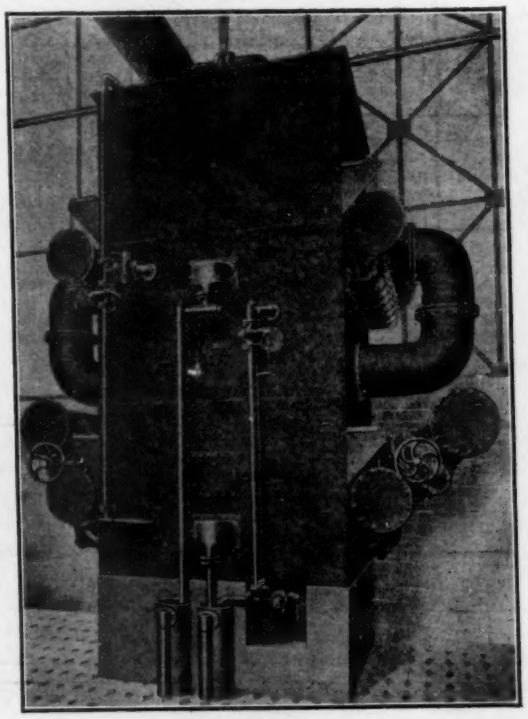


Fig. 1.

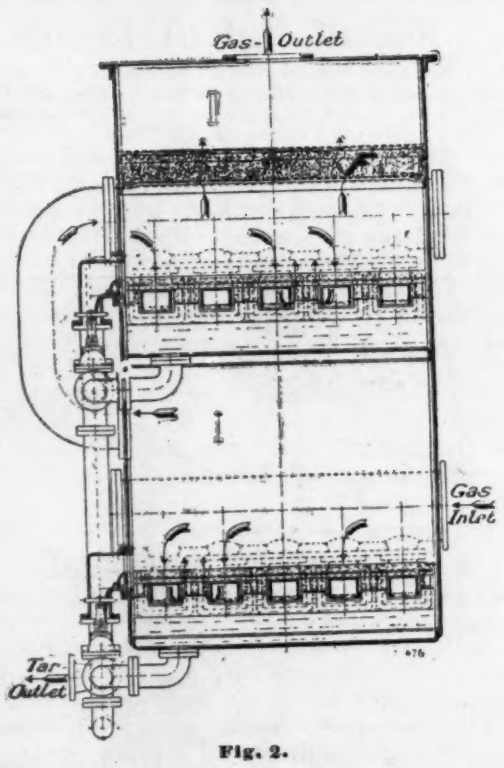


Fig. 2.

The hot tar for the washing is split up into small streams as it enters near the bottom of the shell, and the entering gas, broken up by bubbling through a body of tar in the bottom, meets and mingles with the streams of tar descending. This is repeated in the upper half of the shell, the gas passing through a filter, *F*, and then to the saturator.

When operated at proper temperature it removes every trace of tar, and, when tried at higher heats, only 0.70 gramme of tar per 100 cubic feet remained in the gas.

The hot gas from the ovens is put through a cooler or temperature regulator; next the extractor, then direct to the saturator, where the ammonia is taken up; and through a final water cooler. The sulphate recovered is said to have a good, gray color and to contain 25

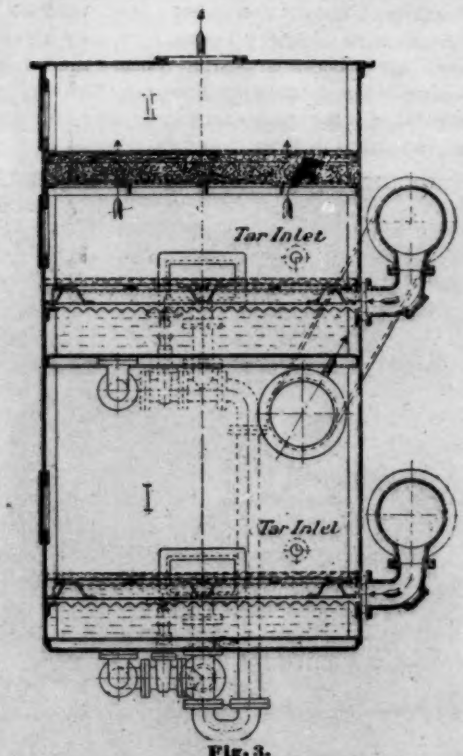


Fig. 3.

per cent. of ammonia. One great economy of the system is in the power required for operation, it using less than 4-horse power, handling the gas from 800 tons of coal, while other plants require nearly 10 times as much.

Recent Patent Issues.

Prepared for the AMERICAN GAS LIGHT JOURNAL by ROYAL E. BURNHAM, solicitor of patents and counselor in patent causes, 833 Bond Building, Washington, D. C., from whom illustrations and specifications of any patent mentioned below may be obtained for 20 cents.

1,079,684. Valve for Gas Burners. E. S. Allen, New York city.

1,079,686. Portable Gas-Log Fireplace. Q. S. Backus, Brandon, Vt.; F. E. Backus, same place, executor of said Q. S. Backus, deceased, assignor to Backus Heater Co.

1,079,849. Gas Cleaner. A. Earnest, Pittsburgh, Pa.

1,079,955. Method of Attaching Inverted Incandescent Mantles to Holders. A. Scheidegger, Basle, Switzerland.

1,080,149. Gas Lamp. J. & G. Keith, London, England.

1,080,212. Attachment for Incandescent Gas Burners. M. Giorgio, Pittsburgh, Pa.

1,080,389. Gas Cut-Off. E. T. Thayer, Jr., Charleston, W. Va.

1,080,445. Absorber and Separator for Gases and Vapors. H. Hey, Dewsbury, England.

Items of Interest
FROM VARIOUS LOCALITIES.

MR. R. B. HOWELL, Water Commissioner, Omaha, Neb., has taken up the matter of an "Occupation Tax," in so far as the artificial lighting supply, telephone service and street tramway operations of that brisk city are concerned. Besides being Water Commissioner, it should also be noted that Mr. Howell is an active, very active, member of the Economic League, which combination is apparently more positively concerned in the "economies" of others than with those of themselves. He presented two schemes, the first of which (the imposition of 15 per cent. direct tax on gross receipts) is so grossly unjust, as to make it seem ridiculous. The "second thought" provides for the enactment of an amendment to the city charter "enabling" the authorities to take over the plant at the expiration of the Gas Company's charter, December, 1918, subject to physical valuation by a properly constituted board of engineering experts, subsequently to be endorsed by a vote of the residents.

"L. V.," writing under date of the 2d inst., says that Mr. J. E. Montgomery, heretofore assistant to Mr. Keating L. Simons, when that gentleman was Superintendent of the gas division, the Birmingham (Ala.) Railway, Light and Power Company, is Acting Superintendent of the like division of the Company's properties. And many of us here hope and believe that the appointment will be made permanent. Mr. Simons now is, as you know, in charge at San Antonio, Tex."

"B. V. T.," writing from Rochester, N. Y., under date of the 5th inst., incloses this: "Several important changes have taken place in the staff of the Warsaw (N. Y.) Gas and Electric Company. Mr. C. W. Torrey, of Perry, who has managed the Perry Electric Company for a year or so, will also act as Manager of the Perry plant, and Mr. E. E. Bennett, also connected with the Perry property for some time, will act as Superintendent at Warsaw. Mr. A. J. Jacobs, now Manager at Warsaw, and Mr. W. E. Hemmenway, former Superintendent in Warsaw, remain with the Company until January 1st."

"DEAR JOURNAL: In the bowling contest for the first December week, between the 'Meter Inspectors' and 'Gas Works' teams, Wilmington (Del.) Company, the latter won three contests straight. The first set was a pretty tight fit, the respective scores being 601 and 599. 'Carson' was mainly responsible for the result; but the 'Meter Men' had no fault to find with the score rolled up by 'Sem'em-up' Driscoll.—ALLEYS."

THE Old Colony (Mass.) Gas Company reports an output for the first 5 months of its fiscal year of 26,700,000 cubic feet; the output for the corresponding period a twelvemonth ago amounted to 18,254,000 cubic feet.

THE Public Service Commission of Indiana has overruled the petition of Frank S. Fishback for a rehearing of the case of the lease of the Indianapolis Gas Company by the Citizens Gas Company. The original hearing, which was exhaustive, and which covered a lengthy period, resulted in the fixing of a leasehold proposition, and under the terms thereof the Citizens proprietors took over and are operating the plant and carrying on the business formerly maintained by the Indianapolis Company. The decision and findings of the Commission were unanimous.

THE "Vo.-Gas" Company, of Manhattan, N. Y., has been incorporated by Messrs. George E. Latham, Maxwell Gottlieb and William Nelson, with headquarters in 25 Pine street. It is capitalized in $100,000, and its avowed object is to deal in "Petroleum and its products."

I. A. FLEMING, writing in the Washington (D. C.) *Herald*, says that Howard S. Reeside will be the next President of the Washington Gas Light Company; he is now Vice-President and Acting President of the Company. Our authority then declares: "Joseph Leiter, the actual President of the Company, is now either on the Mediterranean, or 'Somewhere east of Suez,' or on the road to 'Mandalay,' and does not intend to return to Washington until next September. He has also specifically refused to permit the use of his name as a candidate at the annual election of the Company, which will be held February next."

THE Elkhart (Ind.) Gas and Fuel Company has surrendered its franchise to the Public Service Commission, the Company electing to operate under the indeterminate permit clause of the Utilities Act. Of course, all questions respecting rates will be determined, as before, by the Commission.

ACCORDING to the St. Louis *Republic* the right of the Laclede Gas Light Company, of St. Louis, to charge differential prices, is to be determined by the Public Service Commission. Complaints have been filed in Jefferson City by the C. F. Blake Tea and Coffee Company, the H. P. Coffee Company and the J. H. Forbes Coffee Company, by their joint Attorney, Mr. George B. Webster. In the petition it is set forth that the Company charges the named coffee roasting firms 80 cents per 1,000 cubic feet for the first 10,000 cubic feet supplied, and 60 cents per 1,000 for all quantities in excess of the initial 10,000. The petitioners also ask for an order prohibiting such alleged discrimination.

"A. V.," writing from Fredericksburg, Va., under recent date forwards this: "Eight years ago the old gas plant here was shut down and the new one (now in active commission) started. Under the able supervision of Mr. B. F. Bullock, the present plant never failed in any respect. The antiquated system was replaced by an adequate, modern one, and the satisfactory service rendered, under the

energetic plans of Mr. Bullock, has considerably more than doubled the output. For instance, the last day (November 26, 1912), the old works were in operation, the output for the 24 hours was 31,000 cubic feet; November 26th this year the output was 65,000 cubic feet, and while the output has doubled, the cost of manufacture has been cut 50 per cent. Indeed, the demand for gas was such as to compel the construction of plant 50 per cent. over the original planning, which construction is now well underway. So much for the decadence of the gas industry, as manifested in the happenings of this active Virginia settlement."

THE City Council, of Cameron, Tex., has granted a 25-year franchise to the Butler-Burner Sales Company, of Dallas, under which it may manufacture and distribute gas to the people of Cameron. It is stipulated that at least "10 blocks of piping and equipment" shall have been put in commission on or before January 1, 1914.

WE understand that Mr. William H. Crutcher, who resigned the position of Superintendent of the gas division of the service of the Louisville (Ky.) Gas and Electric Company, has been succeeded by Mr. W. M. Walsh, of Oklahoma City, Okla.

THE plant at Menominee, Mich., is to be enlarged to a point where its output facilities will be increased at least 50 per cent.

"C. C. M.," writing from Hudson City, N. J., under date of the 5th inst., says: "I failed to see any mention in 'our paper' of the meeting last month of the Agents of the Public Service Gas and Public Service Electric Companies, of New Jersey. I am sure this was an inadvertence, accordingly I send you this paragraph or two respecting it. The Agents' meeting was held in the beautiful, commodious main building of the Corporation, North Broad street, the 21st ult., with a fine attendance, which was fully justified by the nature of the proceedings. Not the least entertaining and instructive matter connected therewith was a splendid display of gas and electrical fixtures and appliances, the proper inspection of which virtually took up the morning hours of the assembly. The afternoon sitting was mainly taken up with brisk discussion over ways and-means for the extension of business in general. In was reported on all sides that, while current trading was satisfactory, it was incum bent on them to keep everlastingly at it. The result was a valuable interchange of thought and methods respecting the holding of old and the getting of new business. The proceedings were capably directed by Mr. H. P. Chandler, Division Agent, whose charge concerns the populous centers of Elizabeth, Rahway, Plainfield, Bound Brook, New Brunswick, Somerville, Perth Amboy, South Amboy and Red Bank. Considerably over 100 answered roll call."

HEREAFTER the net rate of $1 per 1,000 cubic feet, on any and all account and use, will prevail in the sales' practice of the Alton (Ills.) Gas and Electric Company. Heretofore the dollar rate was effective only in premises that maintained a gas stove or range.

MRS. MARY F. SISSON, of Indianapolis, Ind., has been retained by the Marquette (Mich.) County Gas and Electric Company, to repair at once to any premises from whence comes complaint respecting defects of any seeming sort in the domestic use of gas. She will also teach the users of gas ranges and the like the best ways-and-means of operating these successfully and economically.

THE Citizens Gas Company, of Indianapolis, Ind., has filed its new schedule of rates (providing for 55-cent gas) with the Public Service Commission. The schedule becomes effective the 1st prox.

THE Corporation Counsel of Jersey City, N. J. (Mr. John Milton), has secured another job for "Prof." E. W. Bemis, of Chicago, who has been retained by Jersey City as "expert" engineer, to assist in the attempt that is to be made before the Public Utilities Commission to order an 80-cent gas rate for Jersey City. "Oh! How we apples float!"

"WE surely did have a fine time in this borough of Reading, Pa., not long ago. The occasion was the homecoming of Mr. and Mrs. John H. Keppelman, the harder half of that partnership being the Superintendent of the Consumers Gas Company, of Reading. The pair had been abroad about two months, and the good ship that carried them safely was the *Grosser-Kuerfuerst*. The place of action was the old headquarters on North Fifth street, the affair was a banquet, the caterer was Mr. Frank Horner, and the hosts were the members of the Gas Employees' Association, headed by President Edward A. Glicker. Besides the viands (all seasonable, well cooked, well served and in plenty), the Philharmonic Orchestra produced fine harmonies. The main speaker, of course, was the guest of honor, who closed a very interesting narrative of their wanderings by thanking his hosts for the warmth of their welcome. Other speeches of an appropriate sort were made by Toastmaster Glicker and Messrs. Bains, Russell, Sands, Hoffman, Horpes, Faille and Romine. The committee in charge of the happening comprised Messrs. Horpes, Levan, Sands, Stoner and Glicker.—M. S. T."

MR. J. LEO HOWLEY, heretofore business representative of the Winchester district of the Arlington Gas Light Company, has been transferred to a similar field in connection with the trading of the Northampton (Mass.) Company.

THE Central Hudson (N. Y.) Gas and Electric Company has determined to extend its service to the outlying settlement of Maybrook. The village authorities have agreed to maintain 22 street lamps on public account, and the stipulation also involves the lighting of the village hall. This action on the part of the Company is certainly good evidence of its enterprise. It will cost at least $12,000 to make the necessary pipe and wiring connections, to supply a place that will not yield at best 90 separate consumers; in fact, the logical supplier should be the Goshen (N. Y.) Company, but Brother Findlay was and is disinclined to take the chances.

MR. STEPHEN P. COBB has resigned from the operating staff of the Ithaca (N. Y.) Gas Company to take employment with the Cayuga Cement Company, the plant of which concern is just north of Ithaca.

MESSRS. HERBERT DUNN, J. A. Haws and L. M. Hutchinson (all well-known residents of Phoenix) have incorporated the Phoenix Gas and Electric Company, capitalized in $10,000. The purpose of the corporation is to manufacture and supply gas and electric currents on any and all accounts. The named place is a post village, of Oswego County, N. Y., located on the Oswego river and the Oswego Canal, at a point 15 miles north of Syracuse. It is also reachable by the lines of the N. Y C. & H. R. Railroad. It maintains some large factories, notably in respect of the production of paper and electrical batteries. Its population does not exceed 2,500; nevertheless it presents an exceedingly good field for the operation of an enterprise like the one under consideration.

AT a regular November meeting of the Northern Westchester Gas and Electric Club, held in Ossining, N. Y, the subject for discussion was "Transformers," the functions, construction and operation of which were minutely and interestingly told by Mr. H. G. Harvey, of the General Electric Company. The lecture was well and plentifully illustrated by stereopticon views. Following the lecture refreshments were served, and at least two-score attended.

MR. RICHARD CHAMPION, formerly in the service of the Old Colony (Mass.) Gas Company, is actively in charge of the affairs of the Norwood (Mass.) Gas Company.

THE American Chemists' Society had their annual dinner in the Highland Hotel, Springfield, Mass., the evening of the 6th inst., with a very gratifying attendance. Prior to dining the assemblage visited the plant of the Springfield Gas Light Company. Amongst the papers read was a very instructive one by Mr. Philip S. Smith, of the Experimental Station, the Massachusetts Agricultural College, whose theme was a *resumé* of the original work of the chemical division of that sterling institution.

AT a meeting of the Gas and Electric Club, the members of which are on the respective staffs of the Athol (Mass.) and the Gardner (Mass.) Gas and Electric Light Companies, held in Engineers' Hall, Athol, the night of the 6th inst., Mr. George T. Mills presided, and Mr. R. G. Sanders acted as Secretary, replacing Mr. R. W. Tupper, whose sudden death (in the interim of meeting times) was reported. Mr. Sanders was later on elected Secretary, and Mr. L. E. Martin was elected Treasurer. Messrs. A. B. Mann, R. G. Sanders and E. L. Martin were appointed a committee to compose suitable resolutions respecting the death of Mr. Tupper.

The Market FOR GAS SECURITIES.

There is no change in quotations for Consolidated gas, the figures of last week (127 to 128) will stand for those of this week. The "rights," although still rather embryotic, in connection with the proposed new stock issue, should be worth not one cent less than 5½, at the present quotation, which it is almost certain will be the lowest one for the balance of this 1913 Jonah financial year. The Standard Gas Light Company's regular semi-annual dividends (3, the preferred and 1½ the common) have been declared, and made payable the 31st inst., to holders of record, the 10th inst.

Brooklyn Union is lifeless, only as to quoations, however; in a business way it never was more active. American Gas (the proprietors of which go along in their smooth, clever way) sold at 101, ex-rights; but it looks to us that 121 would more nearly represent its actual value. The feature of the Philadelphia market some days ago was a happening which looked like a concerted drive at U. G. I. Whether or not, the market greedily absorbed several medium-sized blocks, at an extreme concession of possibly 1½ points. When the offerers were through, the bidders were clamoring for more at 167. It does seem to some well-known and conservative Philadelphia Bourse operators that the Broad street folk, are ready to cut up a grape fruit that even "Hicks, of New York" would rather eat than sell.

Last week The Provident Trust Company, Philadelphia, virtually redeemed seventy-five bonds of the Welsbach Company from the sinking fund account. Interest for the accepted bonds tendered ceased the 9th inst.

Washington (D.C.) gas, largely on the likelihood that that celebrated financier, Mr. Leiter, will be succeeded in the Presidency by Mr. Howard Reeside (who, in fact, is now in charge, while Mr. Leiter is abroad), advanced to 422.

Advices from the Pacific Coast go to show that confidence in gas securities is being restored. As proof of this we note a sale of $10,000 Los Angles (Cal.) Gas and Electric 5's at 98½ *ex* interest, and a sale of 200 Pacific Gas, preferred, at 81.

Massachusetts Gas Companies securities are off a point or so, the recession being attributable to the figures given out respecting the current November output, which was 2.4 per cent. under that for November, 1912. The sellers should have remembered that in 1912 November was the darkest month of the 12, whereas November, '13, had likely a greater number of hours of sunshine with high temperature than of any other November the last 30 years. Messrs. Chapman, Mills & Co., of Chicago, report a ready demand, at 99½ and interest, for the bonds (gold, 6 per cent. per annum), that are being emitted for account of the Hamilton (Ont.) United Gas and Fuel Company.

Peoples, of Chicago, remains unaccountably dull, and the like remark applies to the Lacledes, of both kinds.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.
115 BROADWAY, NEW YORK CITY.
DECEMBER 15.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share:

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked*
Consolidated Gas Co.	$99,616,500	100	127	128
Central Union Gas Co.—				
1st 5's, due 1927, J. & J.	3,500,000	1,000	101	103
Equitable Gas Light Co.—				
Con. 5's, due 1932, M. & S.	1,000,000	1,000	101	104
Mutual Gas Co.	3,600,000	100	157	157
New Amsterdam Gas Co.—				
1st Con. 5's, due 1948, J. & J.	11,000,000	1,000	99	101
New York & Richmond Gas				
Co. (Staten Island)	1,500,000	100	59	62
1st Mtg. Gold Bds. 5 p. ct.	1,500,000	—	98¼	100¾
New York and East River—				
1st 5's, due 1944, J. & J.	3,500,000	1,000	103	105
Con. 5's, due 1945, J. & J.	1,500,000	—	96	100
Northern Union—				
1st 5's, due 1927, J. & J.	1,250,000	1,000	105	108
Standard	5,000,000	100	103	104
Preferred	5,000,000	100	93	94
1st Mtg. 5's, due 1930, M. & N.	1,500,000	1,000	91	95
The Brooklyn Union	15,000,000	1,000	121	126
1st Con. 5's, due 1948, M. & N.	15,000,000	—	106¾	107
Yonkers	299,650	500	130	—
Out-of-Town Companies.				
Cincinnati Gas and Electric Co.	29,500,000	100	67	69
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	96	98
Columbus Gas Light & Fuel Company	1,882,750	100	65¾	66¼
Preferred	3,026,500	100	33	35¾
Consolidated, Baltimore	13,460,084		118¾	119
Mortgages, 5's	3,400,000		—	—
General Mortgage 4½	10,661,000		—	—
Con. Gas Co., Baltimore City, 4½	2,751,000		—	—
Consumers, Toronto	2,000,000	50	200	204
Essex and Hudson Gas Co.	6,500,000	—	133	136
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	—	101
Fort Wayne	2,000,000	—	—	—
" Bonds	2,000,000	—	55	—
Grand Rapids Gas Light Co., 1st Mtg. 5's	1,350,000	1,000	100	101
Hartford	750,000	25	190	200
Hudson County Gas Co., of New Jersey	10,500,000	—	130	139
" Bonds, 5's	10,500,000	—	104	106
Indianapolis	2,000,000	—	85	90
" Bonds, 5's	2,650,000	—	30	99
Jackson Gas Co.	250,000	50	88	—
" 1st Mtg. 5's	200,000	1,000	97	100
Lacledе Gas Co., St. Louis.	10,000,000	100	93¾	94¾
Preferred	2,500,000	100	—	102¾
Bonds	10,000,000	1,000	102¾	103
Madison Gas and Electric Co.				
" 1st Mtg. 6's	400,000	1,000	108	
Massachusetts Gas Companies, of Boston	25,000,000	100	90¾	91
Preferred	25,000,000	100	91	92¾
Peoples Gas Lt. & Coke Co., Chicago	25,000,000	100	116¾	117
1st Mortgage	20,100,000	1,000	102	102¼
2d "	2,500,000	1,000	104	—
Pacific Gas and Electric Co.	15,500,000	—	35	36
St. Joseph Gas Co.—				
1st Mtg. 5's	1,000,000	1,000	96	8

MEETING TIMES OF THE VARIOUS GAS ASSOCIATIONS.

Alabama Light and Traction Company.—Annual meeting, May ——1914. Officers, President, R. L. Ellis, Selma; Treasurer and Secretary, H. O. Hanson, Mobile.

American Gas Institute.—Annual meeting, New York, October 21, 23, 1914. Officers: President, W. H. Gartley, Philadelphia. Secretary, Geo. G. Ramsdell, 29 West 39th st., N. Y. City.

Canadian Gas Association.—Annual meeting————1914. Officers: President, A. A. Dion, Ottawa; Secretary and Treasurer, John Keilior, Hamilton, Ont.

Empire State Gas and Electric Association.—Annual meeting, New York City, Oct. 1914. Officers: President, J. T. Hutchings, Bochester, N. Y.; Secretary, C. H. B Chapin, 29 W. 39th street, New York City.

Gas Meeters.—Monthly Section Meetings; Grand Commissioner, Will. W. Barnes, East Orange, N. J.; Gen'l Sec'y, H Thurston Owens, La Crosse, Wis.; New York Section, Chairman, W. H. Pettes; Secretary, G. E. Smith, Sipp Avenue, Jersey City, N. J Philadelphia Section; Chairman, Stanley Grady; Secretary, H. E. Stiteler, Broad and Arch streets. Cleveland Section, Chairman, F. R. Hutchinson; Secretary, Wm. Holtz, East Ohio Gas Co. New England Section, Chairman, T. W. Jennings, Boston; Sec., F. K. Wells, 60 Broad street, Boston. Winona Section, Winona, Minn., W. F. Clausen, Chairman. Bethlehem Section, Trueman Weithnecht, Chairman; Sec.-Treas., Truman Buss, South Bethlehem, Pa.

Guild of Gas Managers of New England.—Annual meeting, March, 1914. Young's Hotel, Boston; monthly meeting, second Saturday. Officers: President, Walter G. Africa, Manchester, N. H.; Secretary, H. K. Morrison, Brockton, Mass.

Illinois Gas Association.—Annual meeting, March 18th and 19th, 1914. Chicago, Ills. Officers: President, W. F. Barrett, Chicago, Ills.; Secretary-Treasurer, Horace H. Clark, 115 No. Oak Park avenue, Oak Park, Ills.

Illuminating Engineering Society.—Annual meeting, Cleveland, O., September, 1914. Meetings of Sections, monthly. Pres., Charles O. Bond; General Secretary, J. D. Israel, 29 W. 39th street, New York City. Sections: New York, Secretary, C. L. Law, 124 West 43d street. New England, Secretary, H. C. Jones, 10 High street, Boston, Mass. Philadelphia, Secretary, L. B. Eichengreen, Broad and Arch streets. Chicago, Secretary, J B. Jackson, 26 North Market street. Pittsburgh, Secretary, J. C. Mundo, Oliver Building.

Indiana Gas Association.—Annual meeting, March —— —— 1914. Terre Haute. Officers: President, A. S. Cooke, Terre Haute; Vice-President, A. C. Blinn, Evansville; Secretary-Treasurer, Philmer Eves, Indianapolis.

Iowa District Gas Association.—Annual meeting, Davenport, May 27, 28, 29, 1914 Officers: President, B. C. Adams, Lincoln, Neb.; Secretary, G. I. Vincent, Des Moines, Ia.

Kansas Gas, Water and Electric Light Association.—Annual meeting, October—— 1914 Arkansas City. Officers: President, Al. Newman, Arkansas City; Secretary and Treasurer, Ivan Thomas, Wichita Kas.

Michigan Gas Association.—Annual meeting, September, 1914. Place, undetermined. Officers: President, H. W. Douglas, Ann Arbor, Mich; Secretary-Treasurer, Glenn R. Chamberlain, Grand Rapids, Mich.

Missouri Electric Light, Gas, Water Works and Street Railway Association.—Annual meeting, April, 1914; Mexico, Mo. Officers: President, P. A. Bertrand, Joplin, Mo.; Secretary and Treasurer, P. W. Markham, Brookfield, Mo.

National Commercial Gas Association.—Annual meeting and gas show, Dec. 1-6, 1913, Philadelphia, Pa. Officers: President, C. W. Hare, Philadelphia Pa.; Secretary, Louis Stotz, 29 West 39th street, New York City.

Natural Gas Association.—Annual meeting, St. Louis, Mo., May 19 and 20, 1914; Officers: President, E. L. Brundrett, Kansas City, Mo.; Secy-Treas., T. Clive Jones, Delaware, O.

New England Gas Association.—Annual meeting, February, 18th and 19th, 1914. Boston Officers: President, T. H. Hintze, Providence, R. I.; Secretary-Treasurer, N. W. Gifford, East Boston, Mass.

New Jersey State Gas Association.—Next Meeting, —— ——, 1914, Asbury Park N.J. President, C. F. Butcher, Freehold, N. J.; Sec'y-Treasurer, O. F. Potter, Newark, N.J.

Ohio Gas Association.—Annual meeting, February ——— 1914 Columbus, O.; President, John M. Garard, Columbus, O.; Secretary, L. B. Denning, Columbus, O.

Oklahoma Gas, Electric and Railway Association.—Annual meeting, Oklahoma City, May, ——1914. President, F. E. Bowman, Ada; Secretary-Treasurer, H. V. Bozo, Oklahoma City.

Pacific Coast Gas Association.—Annual meeting, Long Beach, Cal., September ——— 1914. Officers: President, C. S Vance, Los Angeles, Cal.; Secretary-Treasurer, Henry B stwick, 445 Sutter street, San Francisco, Cal.

Pennsylvania Gas Association.—Annual meeting, Allentown, Pa., April ———, 1914; Officers, President, J. A. Frick, Allentown, Pa.; secretary-Treasurer, W. O. Lamson, Jr., West Chester, Pa.

Society of Gas Lighting.—Annual meeting Dec., 11, 1913; monthly meetings, second Thursday. Place, New York City. Officers: President, Fred. S. Benson; Secretary, George G. Ramsdell, 29 West 39th street, New York city.

Southern Gas Association.—Annual meeting, Mobile, Ala., April 4, 1914, Officers: President, James Ferrier, Rome, Ga.; Secretary-Treasurer, E. D. Brewer, Atlanta, Ga.

Southwestern Electrical and Gas Association.—Annual meeting, May 22, 23 and 24, 1914, Galveston, Tex. Officers: President, G. H. Gifford, Fort Worth Tex.; Secretary-Treas., J. D. Walker, Dallas, Tex.

Wisconsin Gas Association.—Annual meeting, May ———1914, Milwaukee, Wis. Officers: President, Ewald Hasse, Milwaukee, Wis.; Secretary-Treasurer, Henry Harman Milwaukee, Wis.